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M7 ARMOR TILE IN A NONSTANDARD PLYWOOD BOX UNITED NATIONS (UN) PERFORMANCE ORIENTED PACKAGING (POP) AND MIL-STD-1660 TESTS

Prepared for:
U.S. Army Armament Research, Development and Engineering Center
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The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SIOAC-DEV), was tasked by the U.S. Army Armament Research, Development and Engineering Center (ARDEC) to conduct United Nations (UN) Performance Oriented Packaging (POP) tests on a nonstandard plywood box for shipment of M7 armor tile. Test results indicated that the nonstandard plywood box did not meet the UN POP test requirements. After these initial findings, the project focus was changed from UN POP testing a single container to MIL-STD-1660, Design Criteria for Ammunition Unit Loads, testing a palletized load of containers. MIL-STD-1660 testing was performed on three procedures for palletizing the M7 armor tile. The three palletization procedures tested satisfied MIL-STD-1660 test requirements. The plywood pallet box and unitization procedure for 12 boxes on a 40- by 48-inch pallet should be considered over the unitization procedure for 10 boxes on a 35- by 45-1/2-inch pallet due to the minor bending of the latching mechanism that occurs during unitization.

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PART 1

INTRODUCTION

A. BACKGROUND. The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SIOAC-DEV), was tasked by the U.S. Army Armament Research, Development and Engineering Center (ARDEC) to conduct United Nations (UN) Performance Oriented Packaging (POP) tests on a nonstandard plywood box for shipment of M7 armor tile. Test results indicated that the nonstandard plywood box did not meet UN POP test requirements. After these initial findings, the project focus was changed from UN POP testing a single container to MIL-STD-1660, Design Criteria for Ammunition Unit Loads, testing a palletized load of containers. MIL-STD-1660 testing was performed on three procedures for palletizing the M7 armor tile in a nonstandard plywood box.

B. AUTHORITY. This test was conducted IAW mission responsibilities delegated by the U.S. Army Armament, Munitions and Chemical Command (AMCCOM), Rock Island, IL. Reference is made to the following:

1. Change 4, 4 October 1974, to AR740-1, 23 April 1973, Storage and Supply Activity Operation.

2. AMCCOM-R, 10-17, Mission and Major Functions of USADACS, 13 January 1986.

C. OBJECTIVE. The initial objective was to determine if the nonstandard plywood box would meet UN POP test criteria. The final objective was to determine which palletization procedures satisfied MIL-STD-1660 test requirements.

D. CONCLUSION. The M7 armor tile nonstandard plywood box did not meet UN POP test requirements. Even with the addition of five 3/4-inch steel straps, separation between the end

and sides of the box occurred during the 3.9-foot drop test required by the UN POP test criteria. The three palletization procedures tested satisfied MIL-STD-1660 test requirements. The plywood pallet box and unitization procedure for 12 boxes on a 40- by 48-inch pallet should be considered over the unitization procedure for 10 boxes on a 35- by 45-1/2-inch pallet due to the minor bending of the latching mechanism that occurs during unitization.

PART 2

JANUARY 1997

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PART 3

TEST PROCEDURES

PERFORMANCE ORIENTED PACKAGING (POP) TESTS. The test procedures outlined herein were extracted and summarized from the Bureau of Explosives (BOE) Tariff No. BOE-6000-L, Subpart M, Section 178.600. All tests were conducted to Packing Group II requirements.

A. DROP TEST. Each package will be dropped onto a nonyielding surface from the height and orientations listed below. The drop height is measured as the vertical distance from the target to the lowest point on the package. The drop height for Packing Group I is 1.8 meters (5.9 feet), for Packing Group II it is 1.2 meters (3.9 feet), and Packing Group III is 0.8 meters (2.6 feet).

Packaging	No. of tests	Drop orientation of samples
Steel drums, Aluminum drums, Metal drums (other than steel or aluminum), Steel jerricans, Plywood drums, Wooden barrels, Fiber drums, Plastic drums and jerricans, Composite packagings which are in the shape of a drum.	Six — (three for each drop)	First drop (using three samples): The package must strike the target diagonally on the chime or, if the packaging has no chime, on the circumferential seam or an edge. Second drop (using the other three samples): The package must strike the target on the weakest part not tested by the first drop, for example a closure or, for some cylindrical drums, the welded longitudinal seam of the drum body.
Boxes of natural wood, Plywood boxes, Reconstituted wood boxes, Fiberboard boxes, Plastic boxes, Steel or aluminum boxes, Composite packagings which are in the shape of a box.	Five — (one for each drop)	First drop: Flat on the bottom (using the first sample). Second drop: Flat on the top (using the second sample). Third drop: Flat on the long side (using the third sample). Fourth drop: Flat on the short side (using the fourth sample). Fifth drop: On a corner (using the fifth sample).
Bags — single-ply with a side seam.	Three — (three drops per bag) .	First drop: Flat on a wide face (using all three samples). Second drop: Flat on a narrow face (using all three samples). Third drop: On an end of the bag (using all three samples).
Bags — single-ply without a side seam, or multi-ply	Three — (three drops per bag) .	First drop: Flat on a wide face (using all three samples). Second drop: On an end of the bag (using all three samples).

B. STACKING TEST. The test sample must be subjected to a force applied to the top surface of the test sample equivalent to the total weight of identical packages which might be stacked on it during transport. The minimum height of the stack, including the test sample, must be 3.0 meters (10 feet). The duration of the test must be 24 hours, except that plastic drums, jerricans, and composite packaging 6HH, intended for liquids, shall be subjected to the stacking test for a period of 28 days at a temperature of not less than 40 degrees Celsius (104 degrees Fahrenheit).

Alternative test methods which yield equivalent results may be used if approved by the Associate Administrator for Hazardous Materials Safety.

C. VIBRATION TEST. Three sample packagings, selected at random, must be filled and closed as for shipment. The three samples must be placed on a vibrating platform that has a vertical or rotary double-amplitude (peak-to-peak displacement) of one inch. The packages should be constrained horizontally to prevent them from falling off the platform, but must be left free to move vertically, bounce and rotate. The test must be performed for one hour at a frequency that causes the package to be raised from the vibrating platform to such a degree that a piece of material approximately 1.6 mm (0.063 inch) thickness (such as steel strapping or paperboard) can be passed between the bottom of any package and the platform.

D. PASS/FAIL CRITERIA. A package passes the above tests if there is no rupture or leakage from any of the samples. No test sample should show any deformation which could adversely affect transportation safety or any distortion liable to reduce packaging strength.

MIL-STD-1660 TESTS. The test procedures outlined in this section were extracted from MIL-STD-1660, Design Criteria for Ammunition Unit Loads, 8 April 1977. This standard identifies nine steps that a unitized load must undergo if it is to be considered acceptable. The four tests that were conducted on the test pallets are summarized below.

A. STACKING TEST. The unit load was loaded to simulate a stack of identical unit loads stacked 16 feet high, for a period of one hour. This stacking load was simulated by subjecting the unit load to a compression weight equal to an equivalent 16-foot stacking height. The compression load was calculated in the following manner. The unit load weight was divided by

the unit load height in inches and multiplied by 192. The resulting number was the equivalent compressive force of a 16-foot-high load.

B. REPETITIVE SHOCK TEST. The repetitive shock test was conducted IAW Method 5019, Federal Standard 101. The test procedure is as follows: The test specimen was placed on, but not fastened to, the platform. With the specimen in one position, the platform was vibrated at 1/2-inch amplitude (1-inch double amplitude) starting at a frequency of approximately 3 cycles per second. The frequency was steadily increased until the package left the platform. The resonant frequency was achieved when a 1/16-inch-thick feeler gage momentarily slid freely between every point on the specimen in contact with the platform at some instance during the cycle or a platform acceleration achieved 1 +/- 0.1 Gs. Midway into the testing period, the specimen was rotated 90 degrees and the test continued for the duration. Unless failure occured, the total time of vibration was two hours if the specimen was tested in one position and three hours for more than one position.

C. EDGEWISE ROTATIONAL DROP TEST. This test was conducted using the procedures of Method 5008, Federal Standard 101. The procedure for the edgewise rotational drop test is as follows: The specimen was placed on its skids with one end of the pallet supported on a beam 4-1/2 inches high. The height of the beam was increased if necessary to ensure that there was no support for the skids between the ends of the pallet when dropping took place, but was not high enough to cause the pallet to slide on the supports when the dropped end was raised for the drops. The unsupported end of the pallet was then raised and allowed to fall freely to the concrete, pavement, or similar underlying surface from a prescribed height. Unless otherwise specified, the height of drop for level A protection conforms to the following tabulation:

GROSS WEIGHT (WITHIN RANGE LIMITS) (Pounds)	DIMENSIONS OF ANY EDGE, HEIGHT OR WIDTH (WITHIN RANGE LIMITS) (Inches)	HEIGHT OF DROPS ON EDGES	
		Level A (Inches)	Level B (Inches)
150 - 250	60 - 66	36	27
250 - 400	66 - 72	32	24
400 - 600	72 - 80	28	21
600 - 1000	80 - 95	24	18
1000 - 1500	95 - 114	20	16
1500 - 2000	114 - 144	17	14
2000 - 3000	Above 145 - No limit	15	12
Above - 3000		12	9

D. INCLINE-IMPACT TEST. This test was conducted by using the procedure of Method 5023, Incline-Impact Test of Federal Standard 101. The procedure for the incline-impact test is as follows: The specimen was placed on the carriage with the surface or edge which is to be impacted projecting at least 2 inches beyond the front end of the carriage. The carriage was brought to a predetermined position on the incline and released. If it is desired to concentrate the impact on any particular position on the container, a 4- by 4-inch timber was attached to the bumper in the desired position before the test. No part of the timber was struck by the carriage. The position of the container on the carriage and the sequence in which surfaces and edges are subjected to impacts was at the option of the testing activity and depends upon the objective of the tests. This test is to determine satisfactory requirements for a container or pack, and, unless otherwise specified, the specimen was subjected to one impact on each surface that

has each dimension less than 9.5 feet. Unless otherwise specified, the velocity at time of impact was 7 feet per second.

PART 4

TEST EQUIPMENT

A. COMPRESSION TESTER.

1. Manufacturer:	Ormond Manufacturing
2. Platform:	60- by 60-inches
3. Compression Limit:	50,000 pounds
4. Tension Limit:	50,000 pounds

B. TRANSPORTATION SIMULATOR.

1. Manufacturer:	Gaynes Laboratory
2. Capacity:	6,000-pound pallet
3. Displacement:	1/2-inch amplitude
4. Speed:	50 to 400 rpm
5. Platform:	5- by 8-foot

C. INCLINED PLANE.

1. Manufacturer:	Conbur Incline
2. Type:	Impact Tester
3. Grade:	10 percent incline
4. Length:	12 foot

PART 5

TEST RESULTS

A. UN POP TESTING. Four containers were used for UN POP testing. With each container, UN POP testing began with the worst-case drop due to the fact that the container did not appear to possess the strength needed to meet UN POP test criteria. The 3.9-foot, 45-degree corner drop test was considered to be the worst-case drop for this particular container.

1. Plywood box with two bundling wires. During the first test, a plywood box with two bundling wires around the box, perpendicular to the long axis of the box, was dropped at a 45-degree angle onto one corner of the box from a height of 3.9 feet. The box was substantially damaged as a result of the drop test. One of the sides of the box shifted enough to create a gap big enough to allow the inert fill to spill from the box and break one of the wooden cleats at the opposite end of the box.

2. Plywood box with four bundling wires. During the second test, a plywood box with four bundling wires around the box, perpendicular to the long axis of the box, was dropped at a 45-degree angle onto one corner of the box from a height of 3.9 feet. This box was damaged in a similar fashion as the container that was dropped during the first test.

3. Plywood box with two bundling wires and two 3/4-inch steel straps. During the third test, a second box with two bundling wires was modified to include two additional 3/4-inch steel straps around the box, perpendicular to the long axis of the box, approximately 1/2-inch from the ends of the box. This modified box was also dropped at a 45-degree angle onto one corner of the box from a height of 3.9 feet. As during the first two drops, the sides of the box shifted from the ends enough to allow the inert fill to spill from the box. Separation between the sides and top of the box also occurred.

4. Plywood box with two bundling wires and five 3/4-inch steel straps. During the fourth and final drop, a box with four bundling wires was modified to include five additional 3/4-inch steel straps. Three straps were added around the box, perpendicular to the long axis of the box, at the middle and approximately 1/2-inch in from either end. The remaining two straps were added lengthwise around the box over the middle of the wooden cleats at either end of the box. This final box was again dropped at a 45-degree angle onto one corner of the box from a height of 3.9 feet. Damage from the drop test consisted of separation of the sides from the ends and separation from the sides with the top and bottom in between the middle and end straps. These gaps were big enough to allow the inert fill to fall from the box.

B. MIL-STD-1660 TESTING. Three unitization procedures for the M7 armor tile in a non-standard plywood box were prepared and MIL-STD-1660 tested. The plywood pallet box and 40- by 48-inch pallet were capable of moving 12 plywood boxes while the 35- by 45-1/2-inch pallet was only designed to handle 10 plywood boxes.

1. MIL-STD-1660 testing of a plywood pallet box loaded with 12 M7 armor tile boxes. Results from the MIL-STD-1660 testing indicated that the plywood pallet box provided adequate protection for shipment of the M7 armor tile in a non-standard plywood box. Results from the individual tests that comprise MIL-STD-1660 are shown below.

a. Pallet Specifications (10 actual boxes and 2 simulated boxes).

Test Date:	28 Dec 95
Weight:	1,935 pounds
Length:	48 inches
Width:	41-3/4 inches
Height:	51-3/4 inches

b. Compression Test. The pallet was compressed with a load force of 7,180 pounds for a period of 60 minutes. During the compression test, the pallet height was reduced to 51-5/8 inches. No damage was noted as a result of this test.

c. Repetitive Shock Test. The test pallet was vibrated 90 minutes at 190 rpm in the longitudinal orientation and 90 minutes at 150 rpm in the lateral orientation. No damage or loosening of the load was noted as a result of this test.

d. Edgewise Rotational Drop Test. The test pallet was edgewise rotationally dropped from a height of 24 inches on the longitudinal drops and 23 inches on the lateral drops (maximum elevation achievable without toppling the pallet). No damage or shifting of the load was noted as a result of this test.

e. Incline-Impact Test. The test pallet was incline-impacted on all four sides from a height of 8 feet. No damage or shifting of the load was noted as a result of this test.

f. Post Test Inspection. Upon completion of MIL-STD-1660 testing, the pallet box was disassembled and the contents were inspected for damage. Two boxes were noted to have broken bundling wires and several boxes showed minor separation between the sides of the box and the box bottom. The contents in the box remained secured.

2. MIL-STD-1660 testing of unitization procedures for 12 M7 armor tile boxes on a 40- by 48-inch pallet. Results from MIL-STD-1660 testing indicated that the procedures for shipping 12 tile boxes on a 40- by 48-inch pallet were adequate. Results from the individual tests that comprise MIL-STD-1660 are shown below.

a. Pallet Specifications (10 actual boxes and 2 simulated boxes).

Test Date:	02 Jan 96
Weight:	1,705 pounds
Length:	48 inches
Width:	40 inches
Height:	49-3/4 inches

b. Compression Test. The test pallet was compressed with a load force of 6,680 pounds for a period of 60 minutes. During the compression test, the pallet height was reduced to 49-1/2 inches. No damage was noted as a result of this test.

c. Repetitive Shock Test. The test pallet was vibrated 90 minutes at 170 rpm in the longitudinal orientation and 90 minutes at 190 rpm in the lateral orientation. No damage or loosening of the load was noted as a result of this test.

d. Edgewise Rotational Drop Test. The test pallet was edgewise rotationally dropped from a height of 24 inches on the longitudinal drops and 23 inches on the lateral drops (maximum elevation achievable without toppling the pallet). No damage or shifting of the load was noted as a result of this test.

e. Incline-Impact Test. The test pallet was incline-impacted on all four sides from a height of 8 feet. No damage and only minor shifting of the load was noted as a result of this test.

f. Post Test Inspection. At the completion of MIL-STD-1660 testing, the pallet box was disassembled and the contents were inspected for damage. Only minor cracking of the 1-inch dunnage was noted.

3. MIL-STD-1660 testing of unitization procedures for 10 M7 armor tile boxes on a 35- by 45-1/2-inch pallet. Results from MIL-STD-1660 testing indicated that the procedures for shipping 10 tile boxes on a 35- by 45-1/2-inch pallet were adequate; however, this unitization procedure has one major drawback. Since there is no internal blocking, the latch of one plywood box presses into the back of the adjacent plywood box causing the eyelet of the latch to bend. The eyelet must be straightened before the latch can be opened. Results from the individual tests that comprise MIL-STD-1660 are as follows.

a. Pallet Specifications (10 boxes).

Test Date:	10 Jan 96
Weight:	1,360 pounds
Length:	49-1/4 inches
Width:	36-1/4 inches
Height:	35 inches

b. Compression Test. The test pallet was compressed with a load force of 7,460 pounds for a period of 60 minutes. During the compression test, the pallet height was reduced to 34-3/4 inches. No damage was noted as a result of this test.

c. Repetitive Shock Test. The test pallet was vibrated 90 minutes at 220 rpm in the longitudinal orientation and 90 minutes at 195 rpm in the lateral orientation. No damage or loosening of the load was noted as a result of this test.

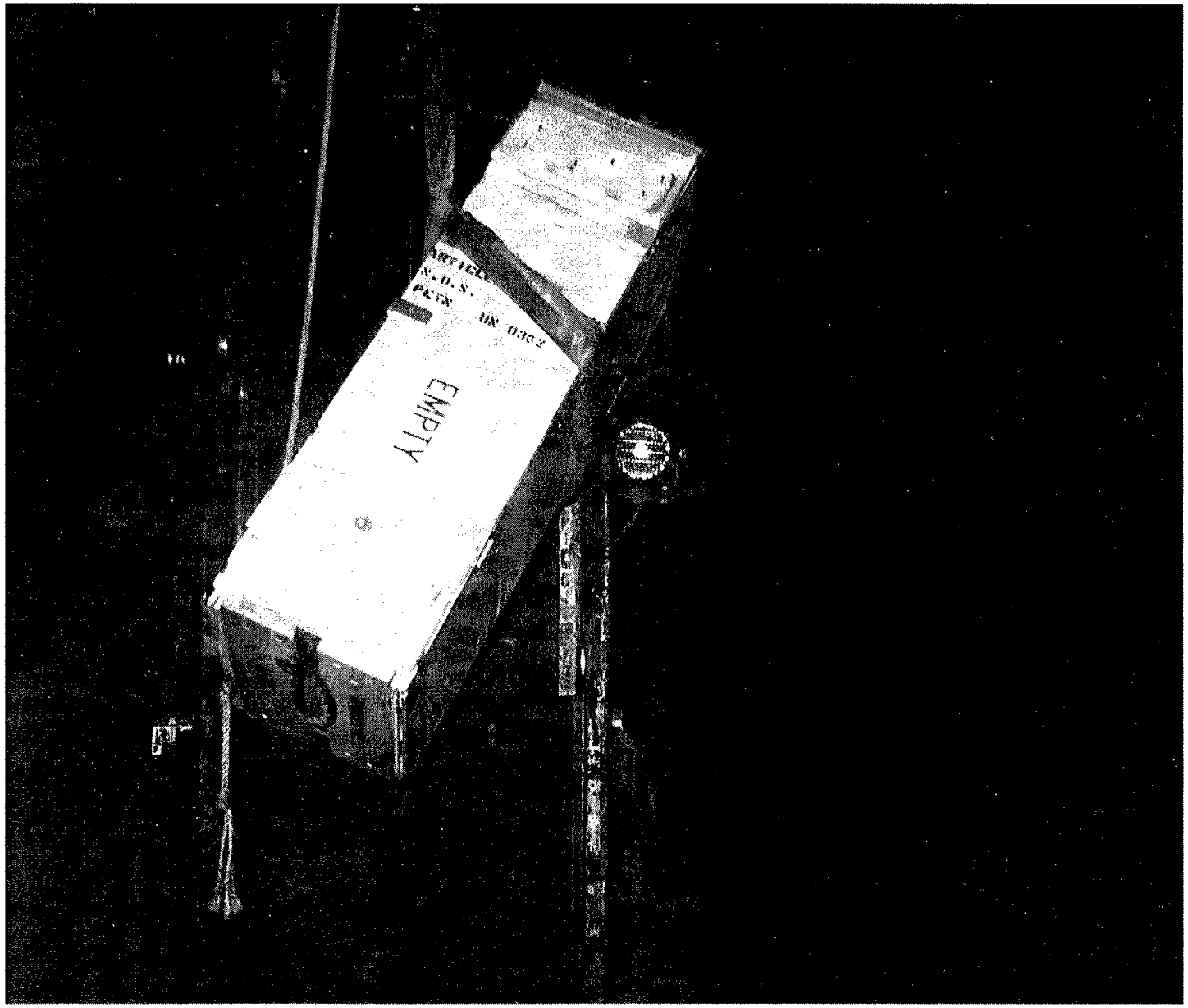
d. Edgewise Rotational Drop Test. The test pallet was edgewise rotationally dropped from a height of 24 inches on all four sides. No damage or shifting of the load was noted as a result of this test.

e. Incline-Impact Test. The test pallet was incline-impacted on all four sides from a height of 8 feet. No damage and or shifting of the load was noted as a result of this test.

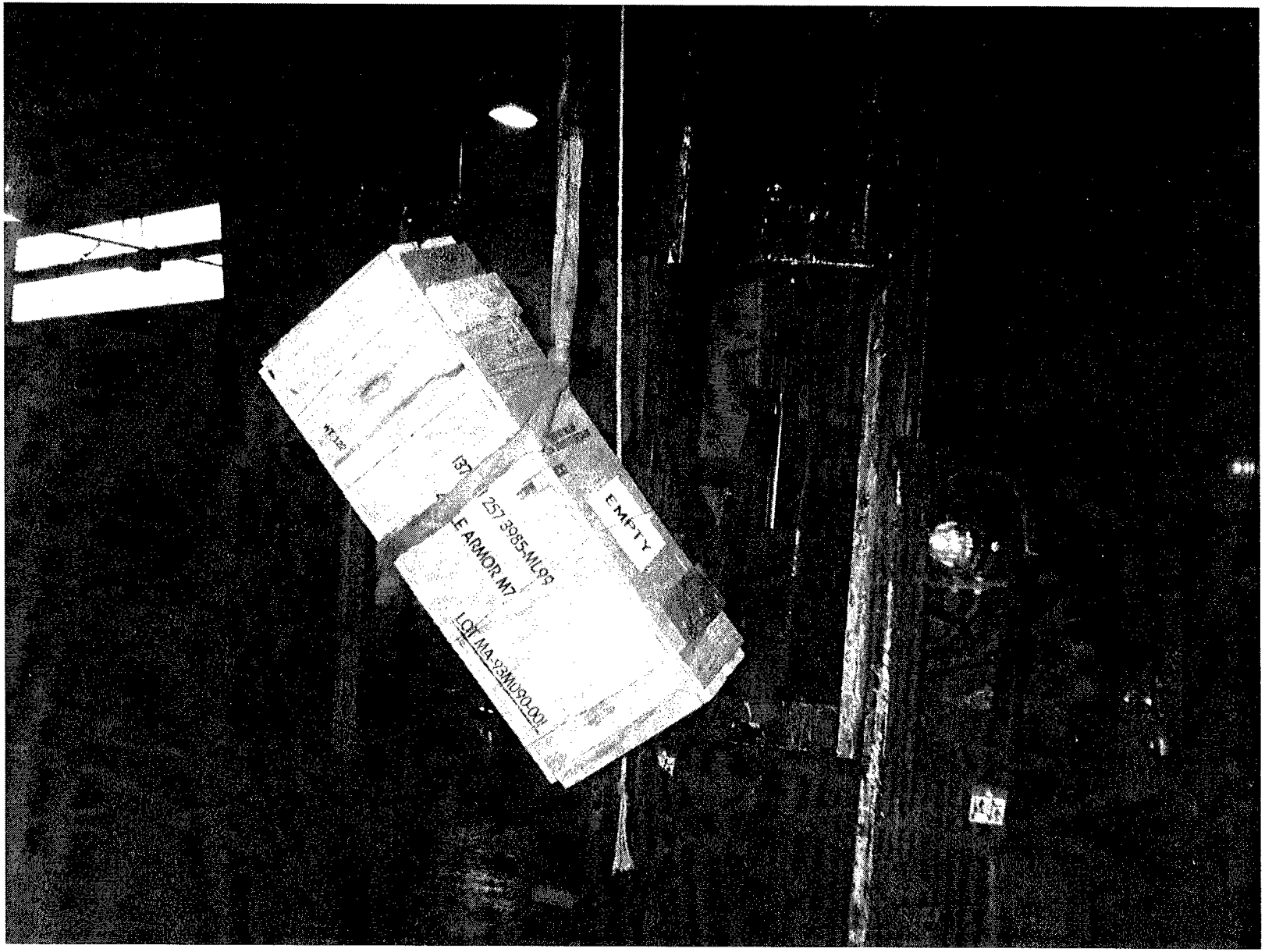
f. Post Test Inspection. Upon completion of MIL-STD-1660 testing, the pallet box was disassembled and the contents were inspected for damage. The only damage observed was the bending of the eyelet of the latch that was noted at the beginning of the test.

PART 6

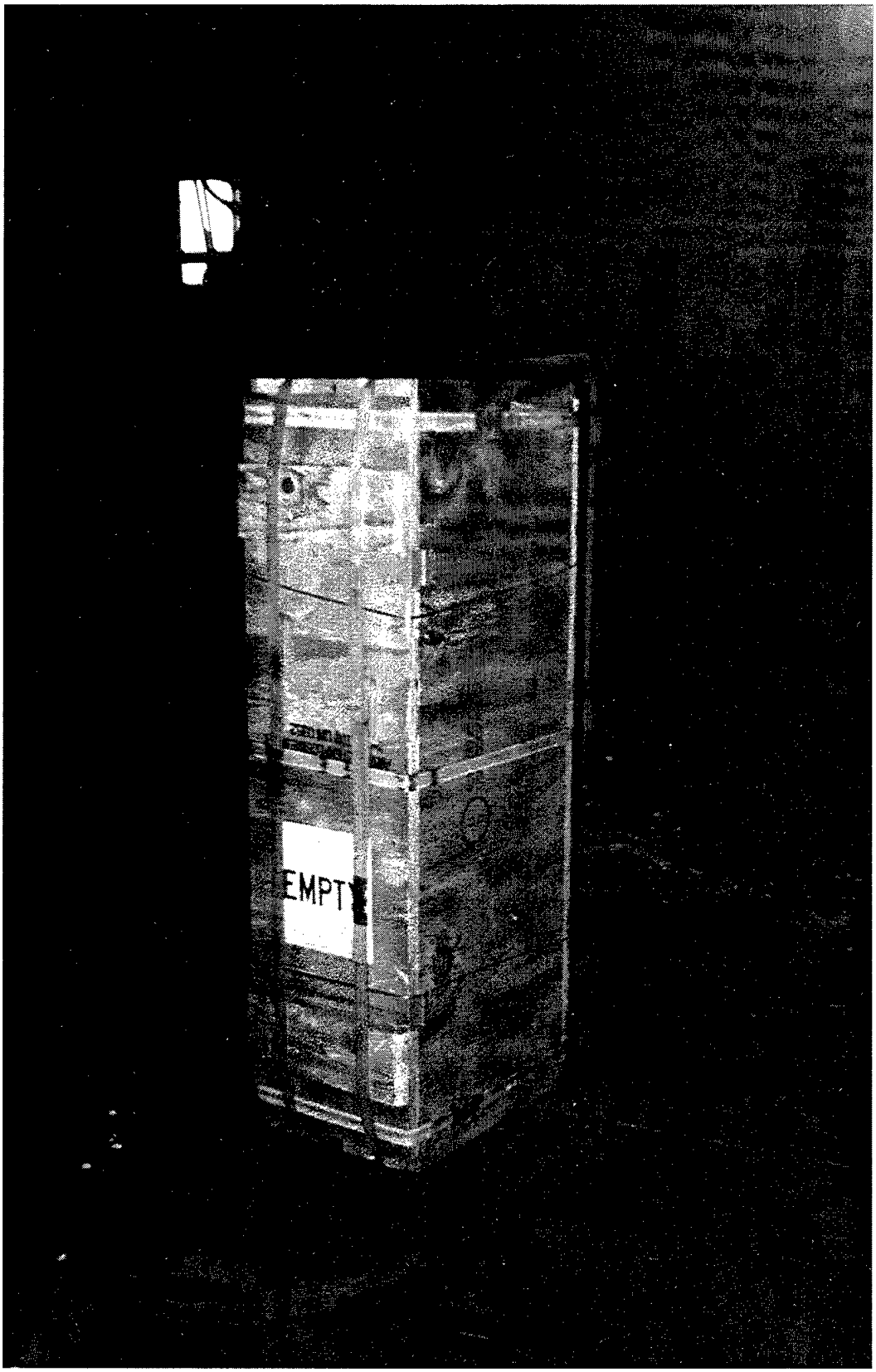
PHOTOGRAPHS



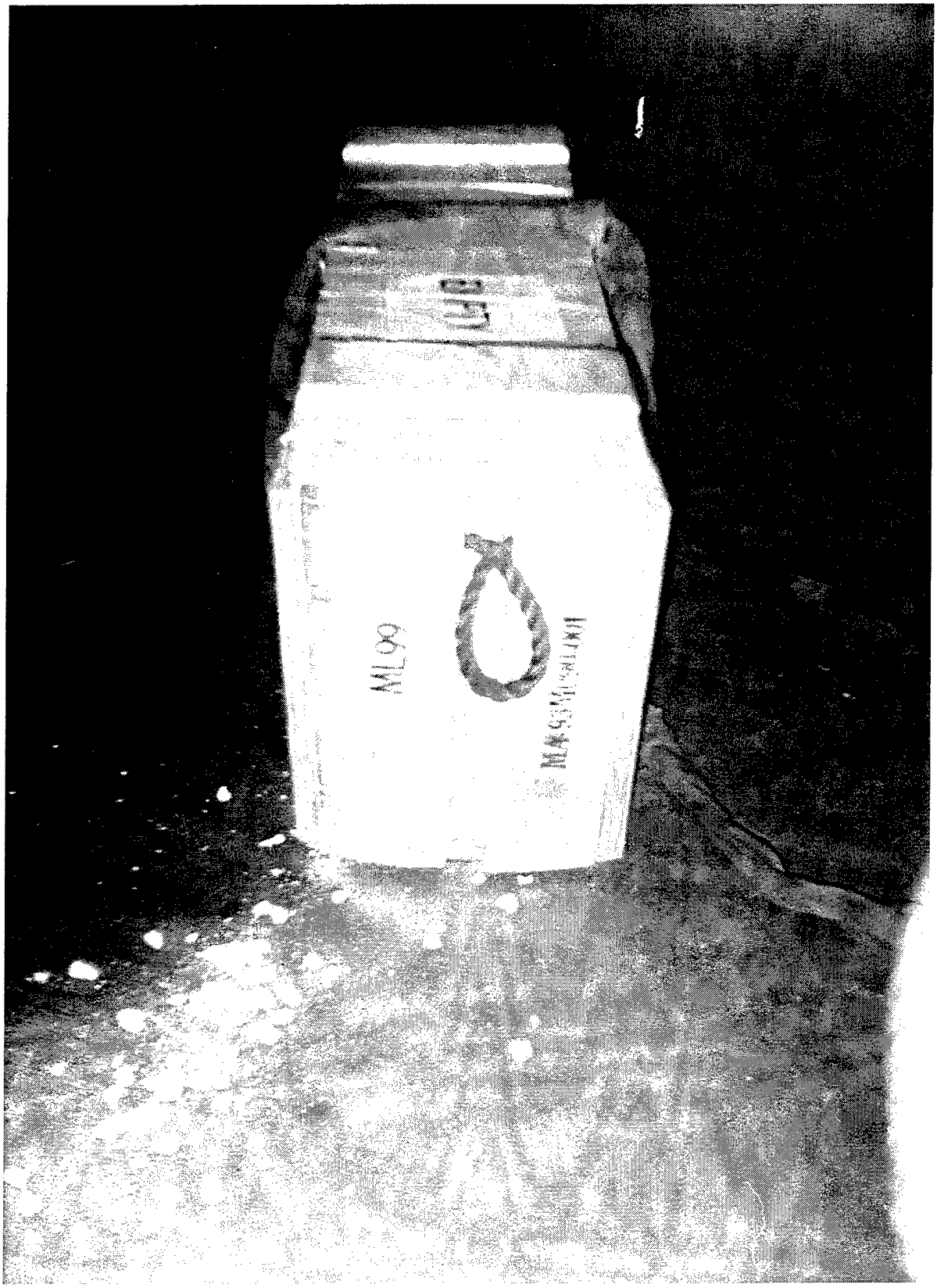
	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
AO317-SPN-96-089-1126. This photograph shows the armor tile box with two bundling wires raised to 3.9 feet for the 45-degree angle drop required for UN POP certification.		



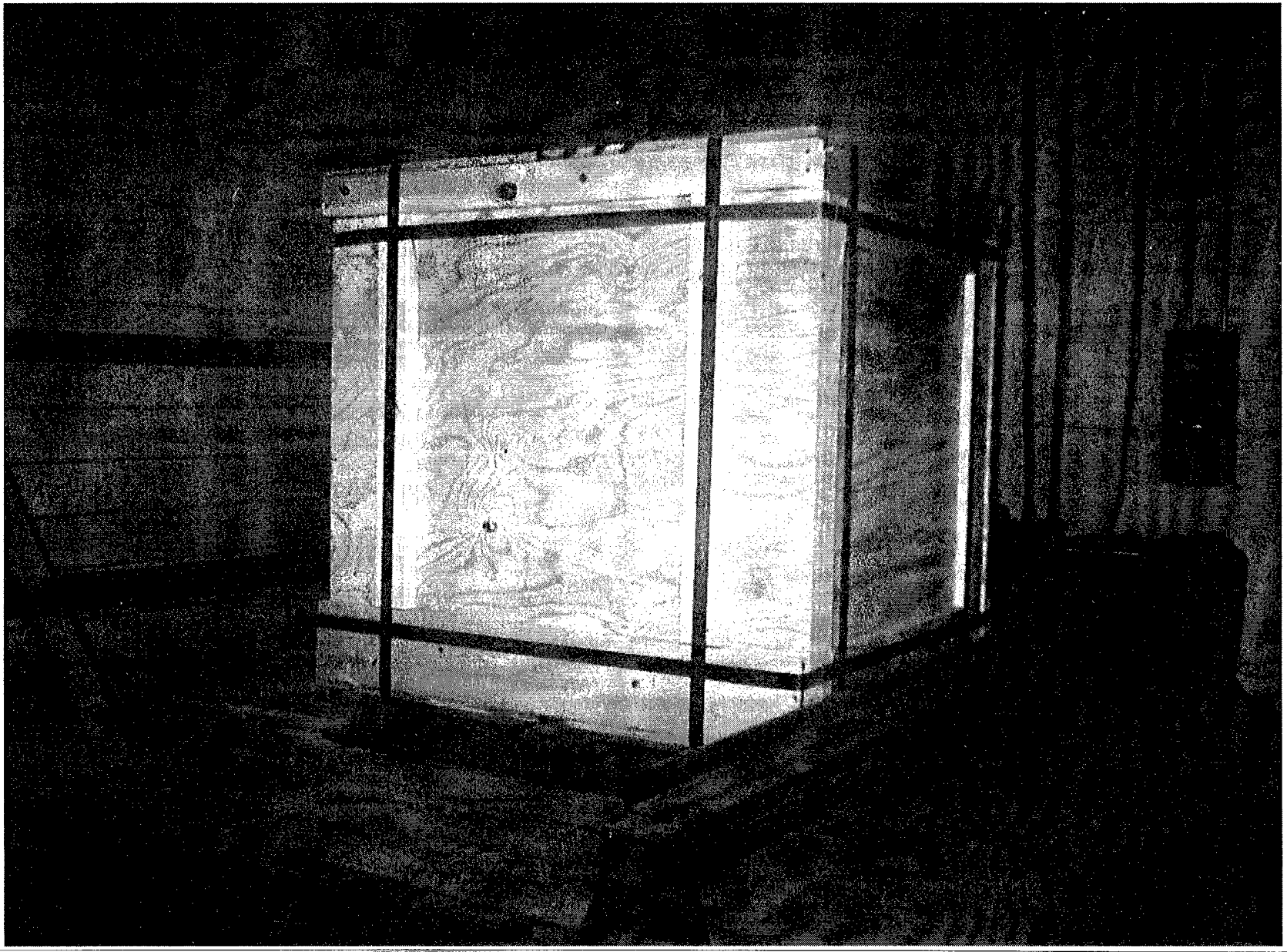
	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
AO317-SPN-96-089-1122. This photograph shows the armor tile box with four bundling wires raised to 3.9 feet for the 45-degree angle drop required for UN POP certification.		



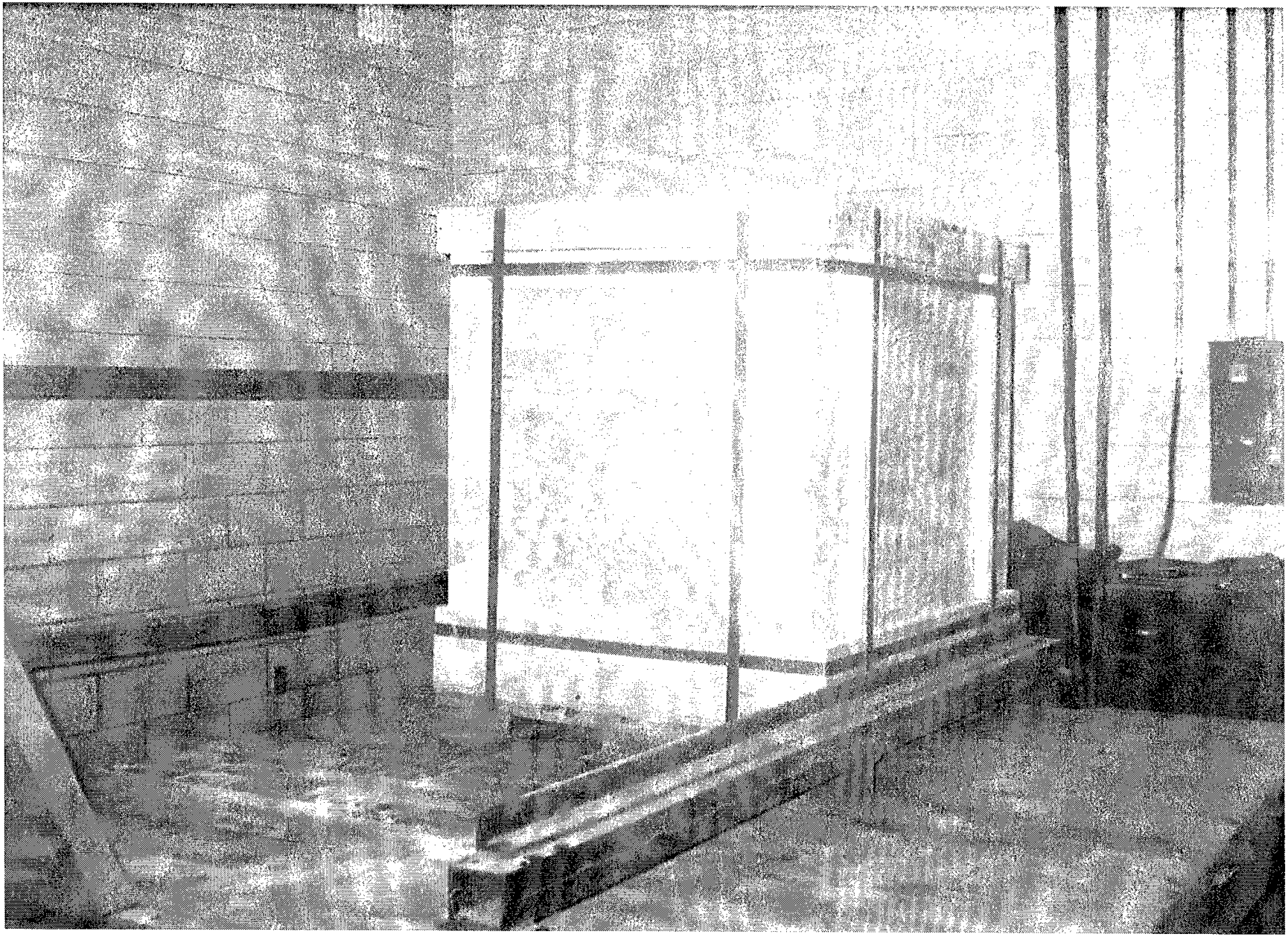
	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
AO317-SPN-96-089-1130. This photograph shows the armor tile box with five 3/4-inch steel straps after the 3.9-foot, 45-degree angle drop.		



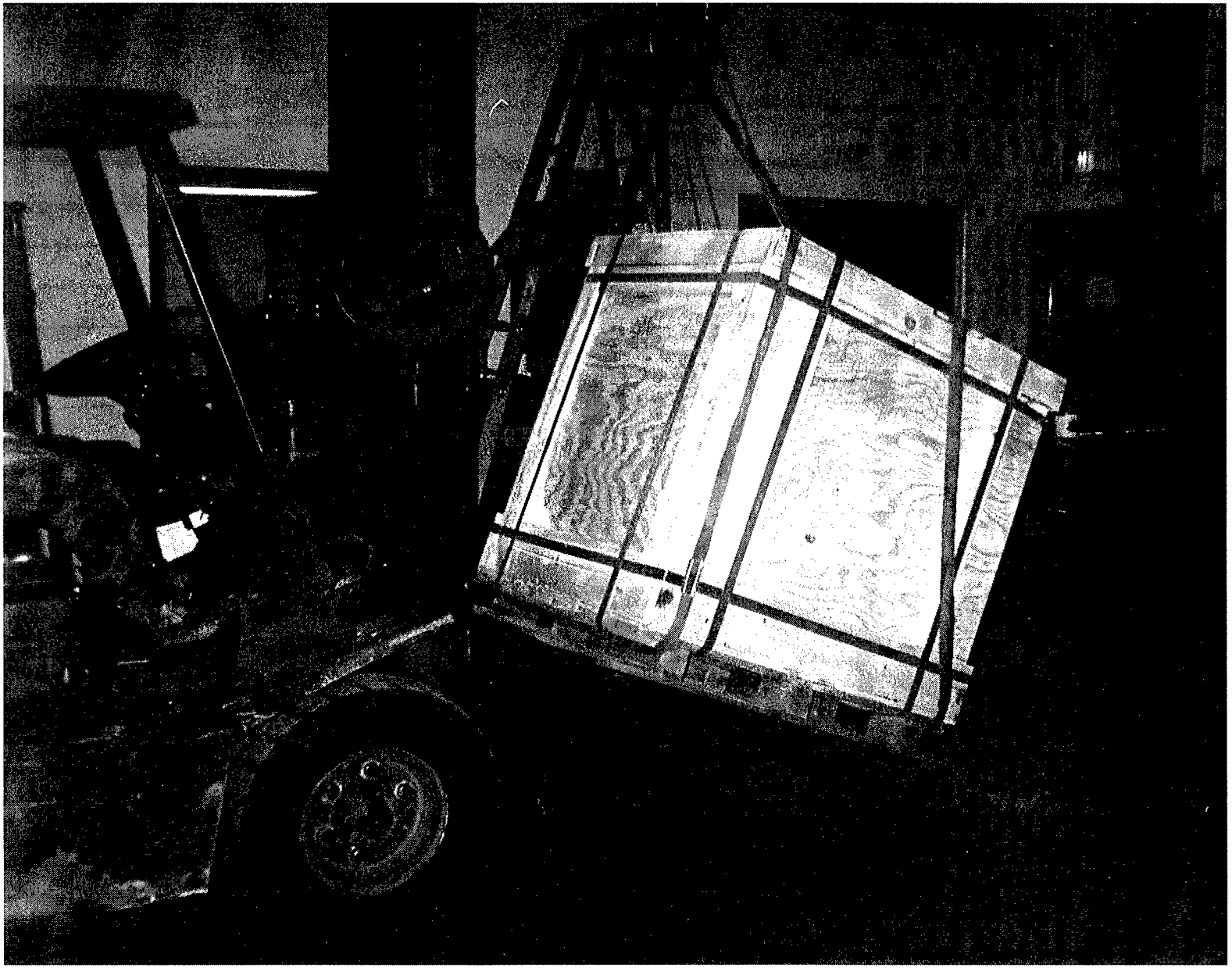
	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
AO317-SPN-96-089-1123. This photograph shows typical damage experienced by the armor tile box during the 3.9-foot, 45-degree angle drop required for UN POP certification.		



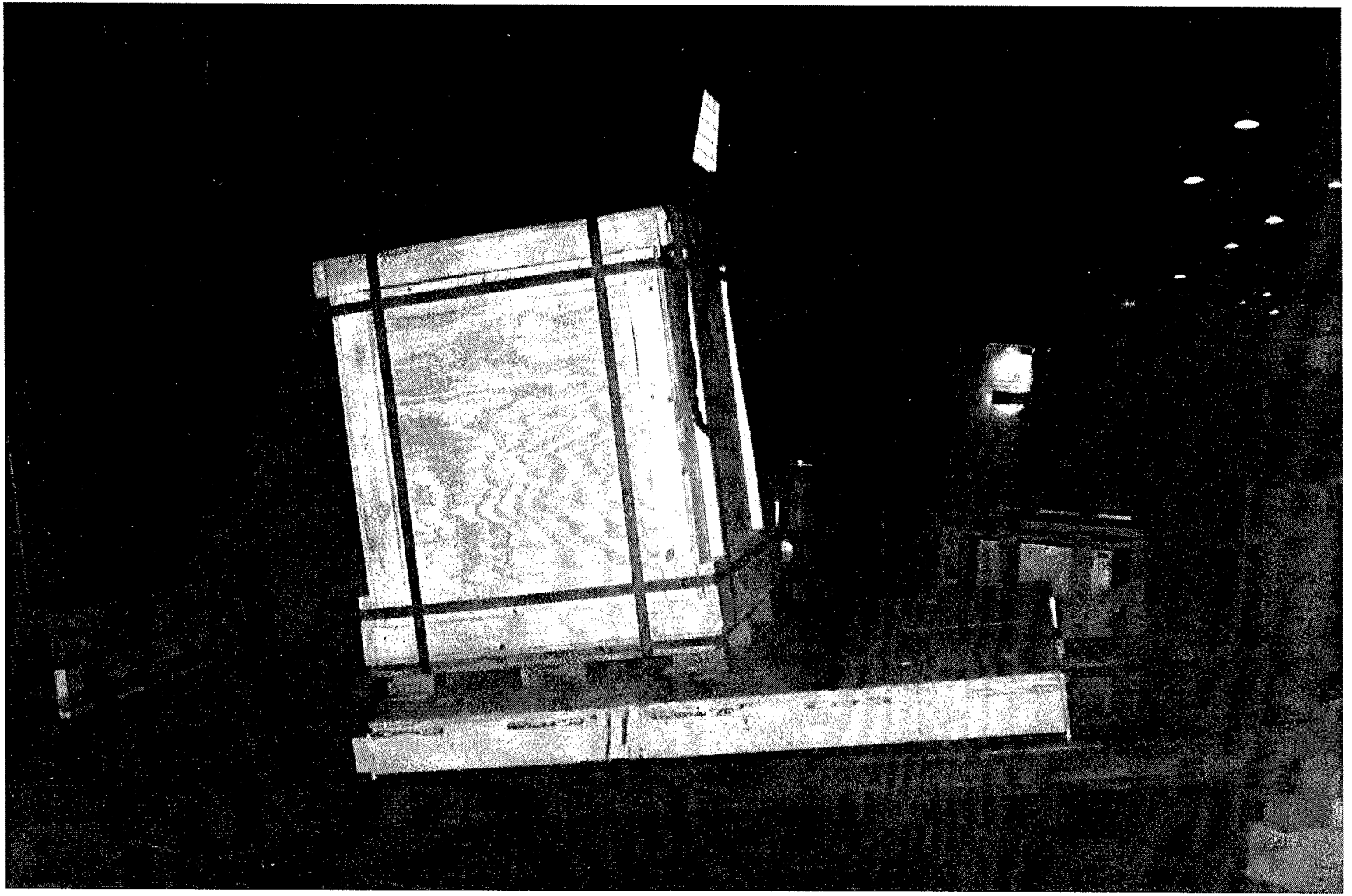
	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
AO317-SPN-96-089-1136. This photograph shows the pallet box on the vibration table in the longitudinal orientation.		



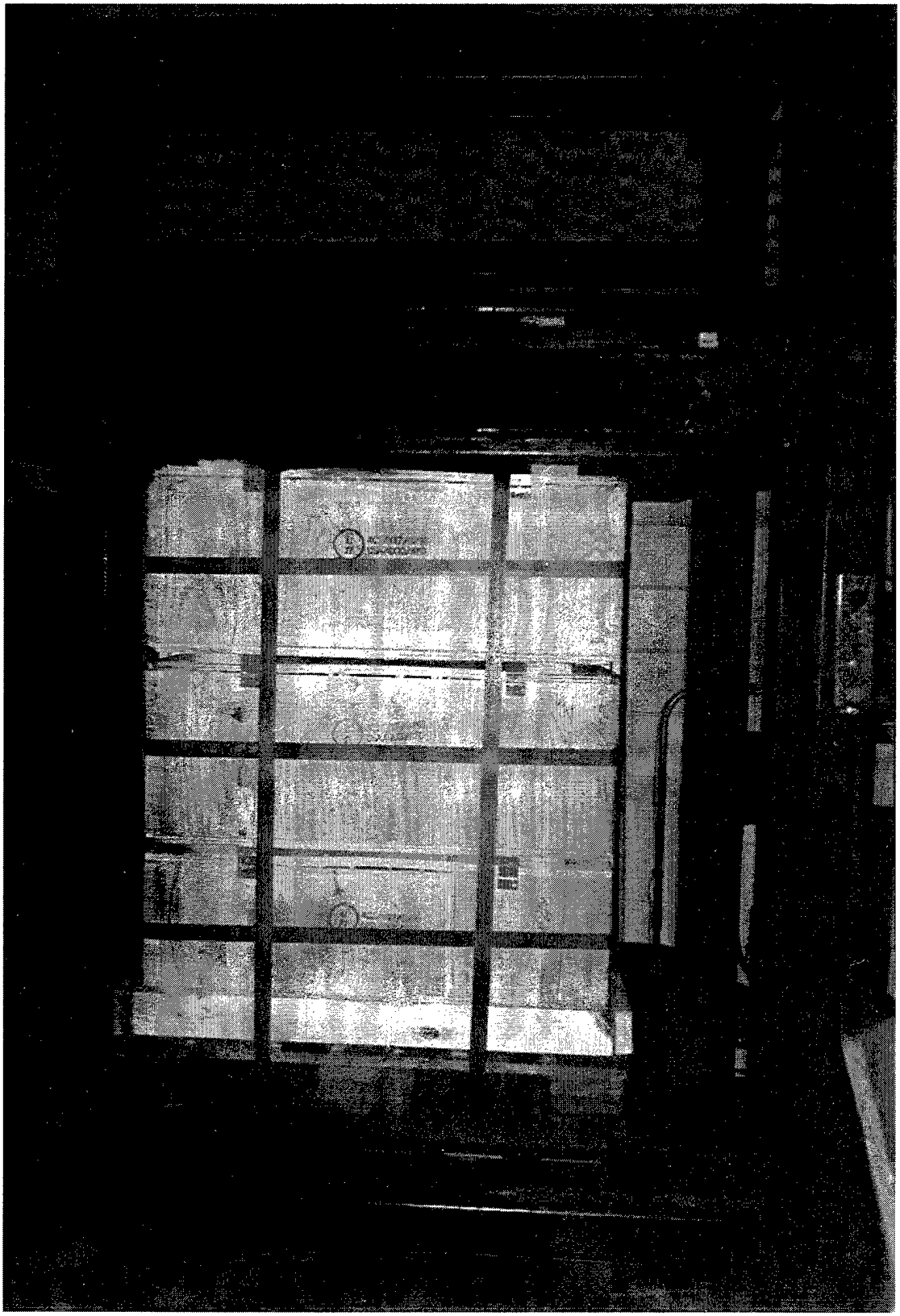
	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
AO317-SPN-96-089-1137. This photograph shows the pallet box on the vibration table in the lateral orientation.		



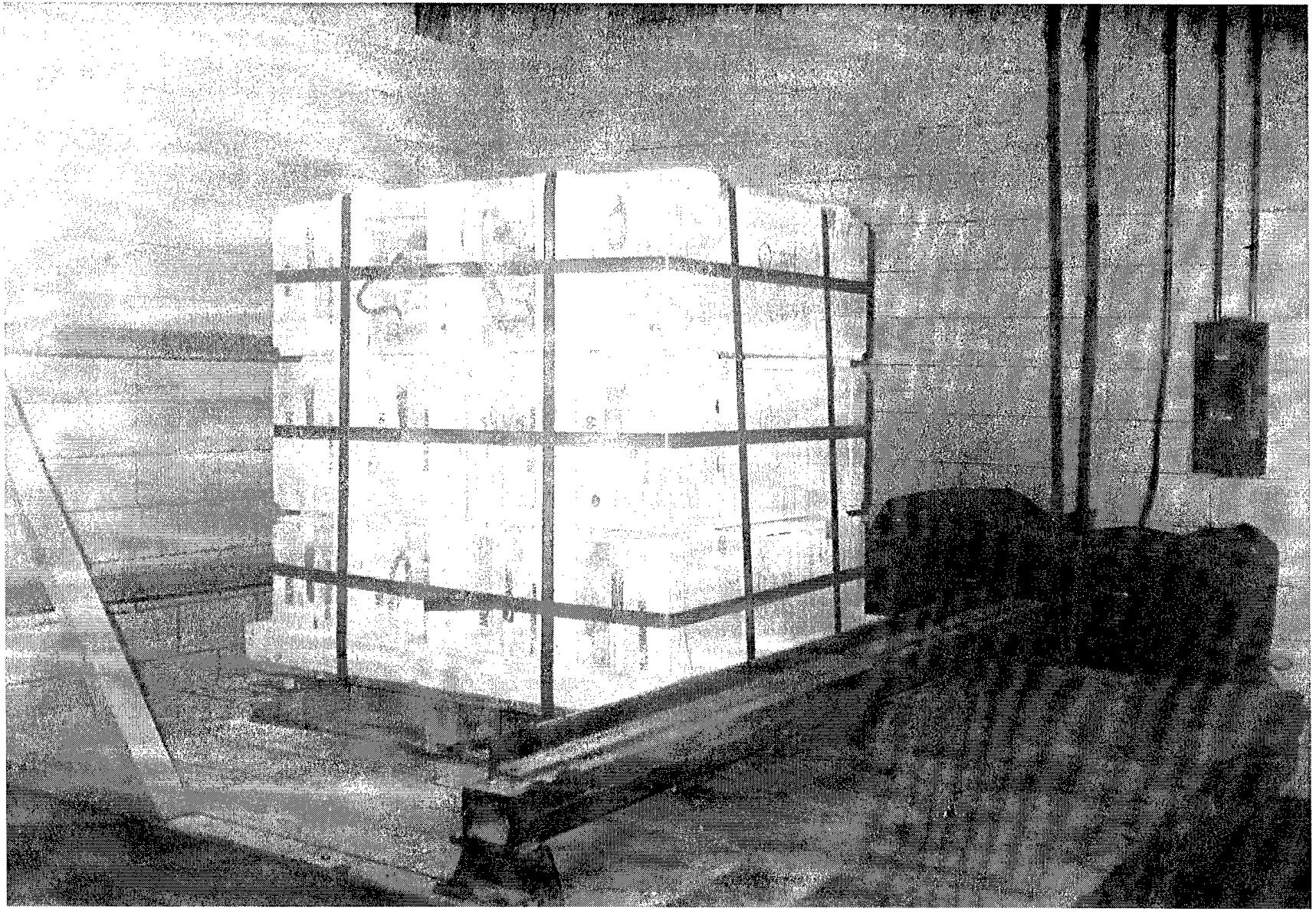
	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
AO317-SPN-96-089-1139. This photograph shows the pallet box raised in preparation for the edgewise rotational drop test.		



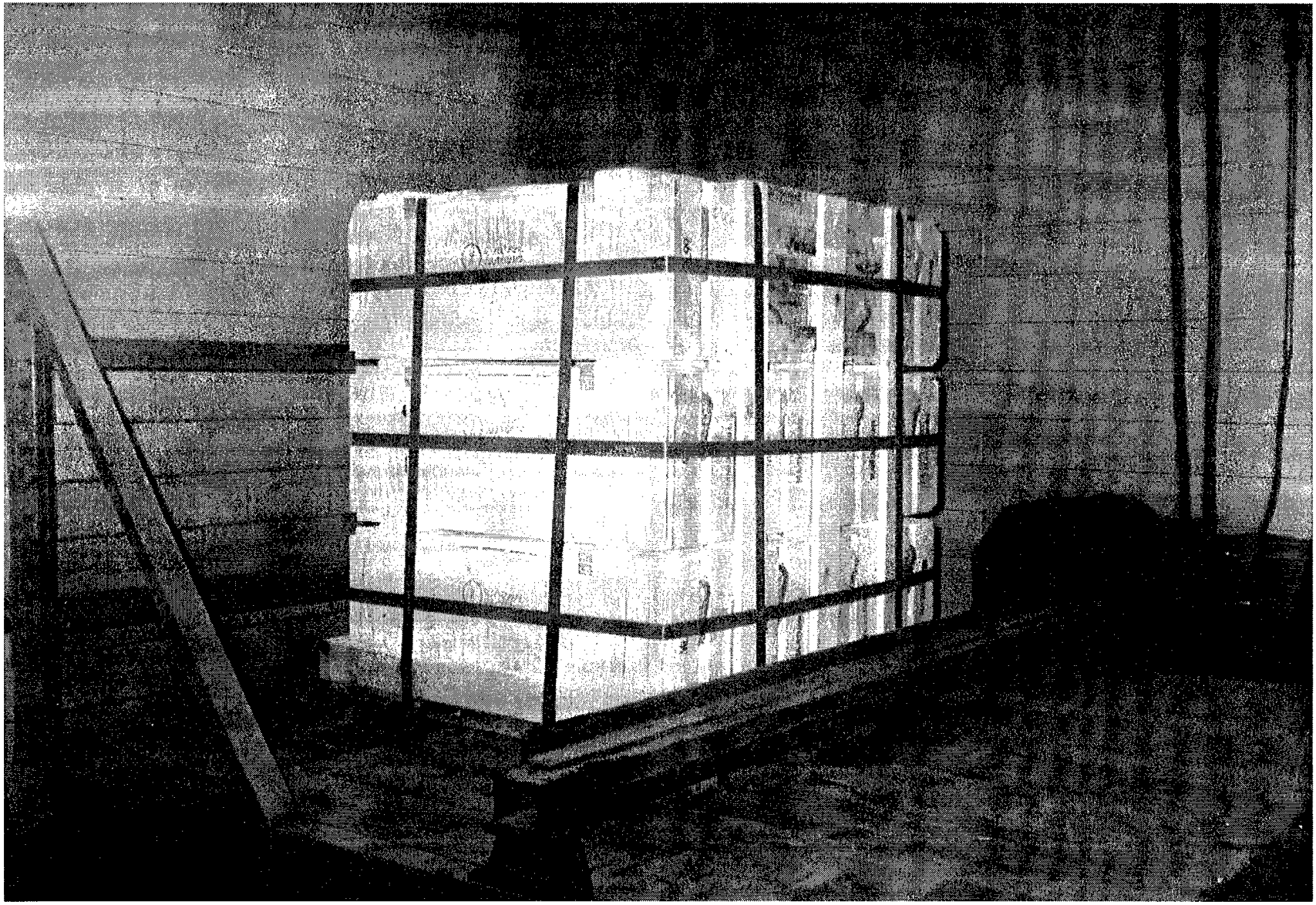
	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
AO317-SPN-96-089-1142. This photograph shows the pallet box on the incline-impact tester.		



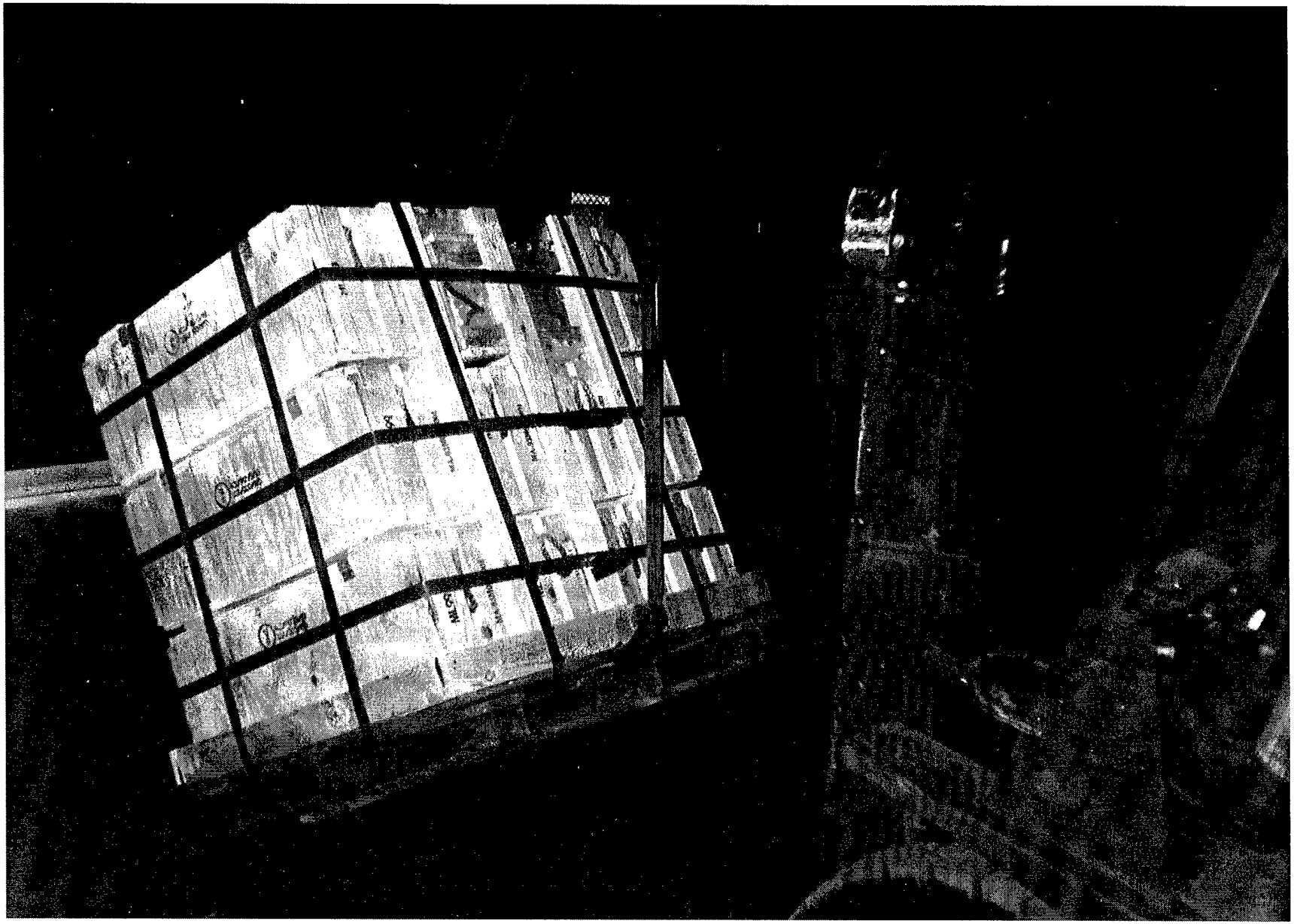
	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
AO317-SPN-96-089-1150. This photograph shows the armor tile pallet (palletization method no. 1) in the compression tester.		



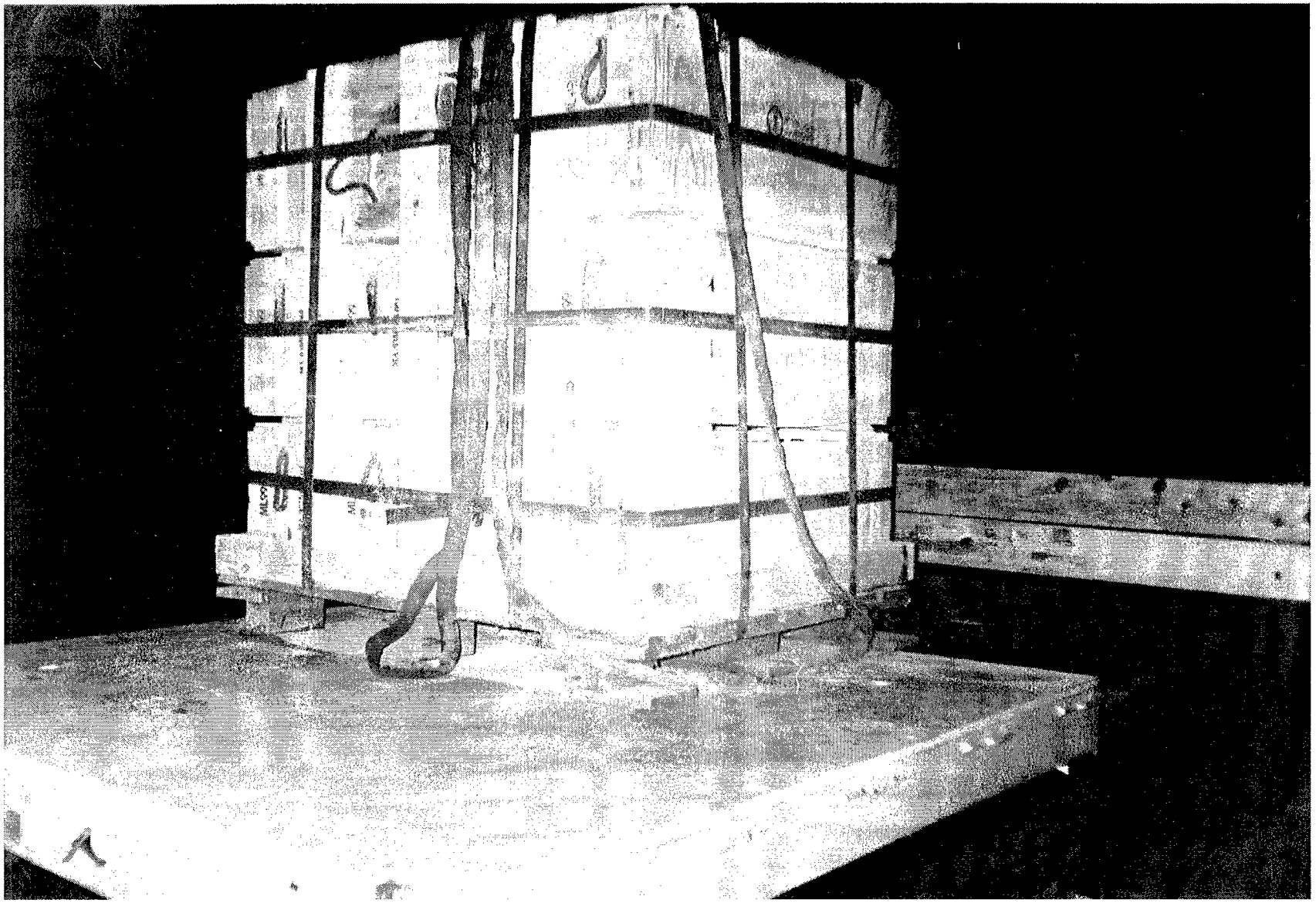
	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
AO317-SPN-96-089-1151. This photograph shows the armor tile pallet (palletization method no. 1) on the vibration table in the longitudinal orientation.		



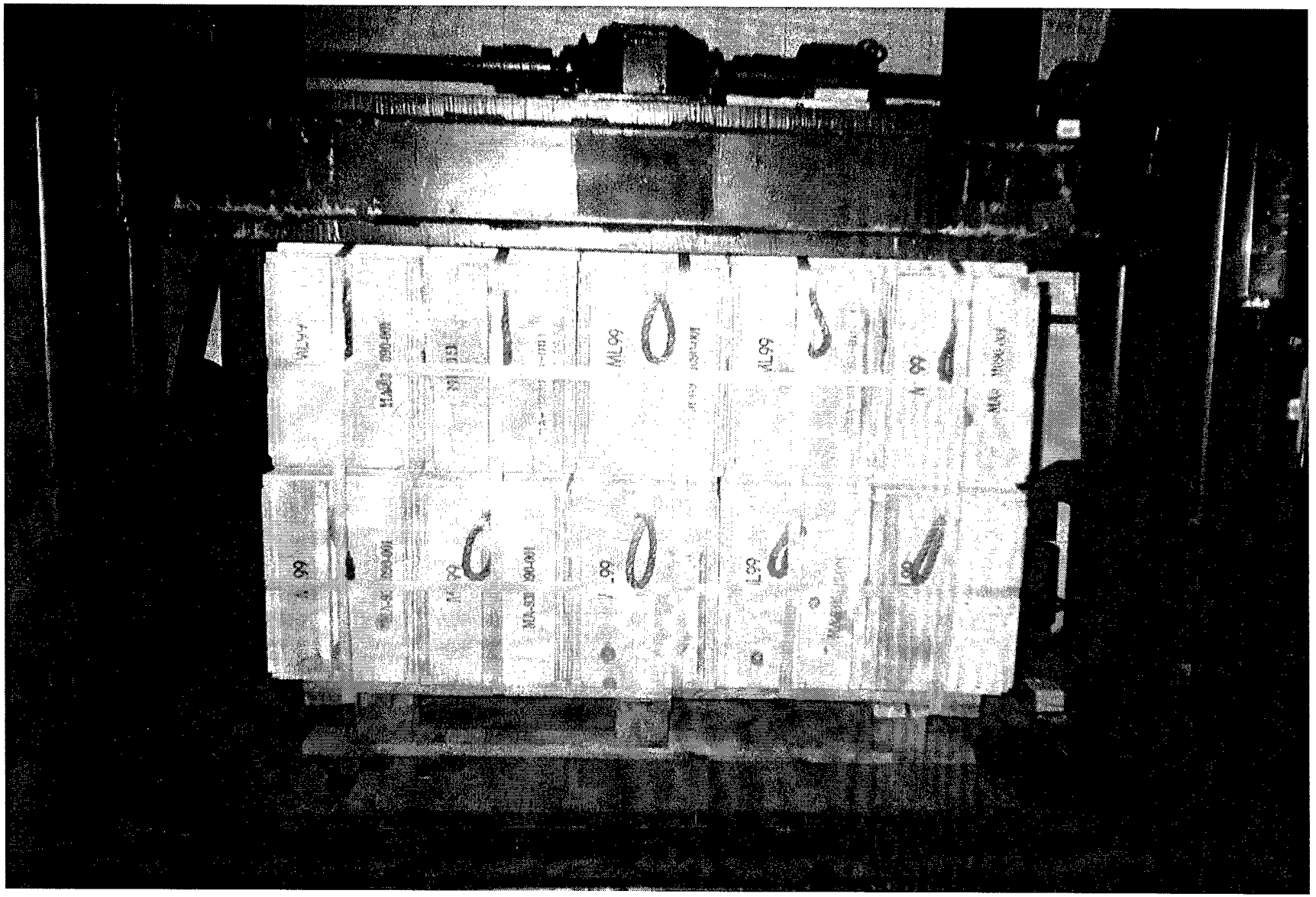
	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
AO317-SPN-96-089-1152. This photograph shows the armor tile pallet (palletization method no. 1) on the vibration table in the lateral orientation.		



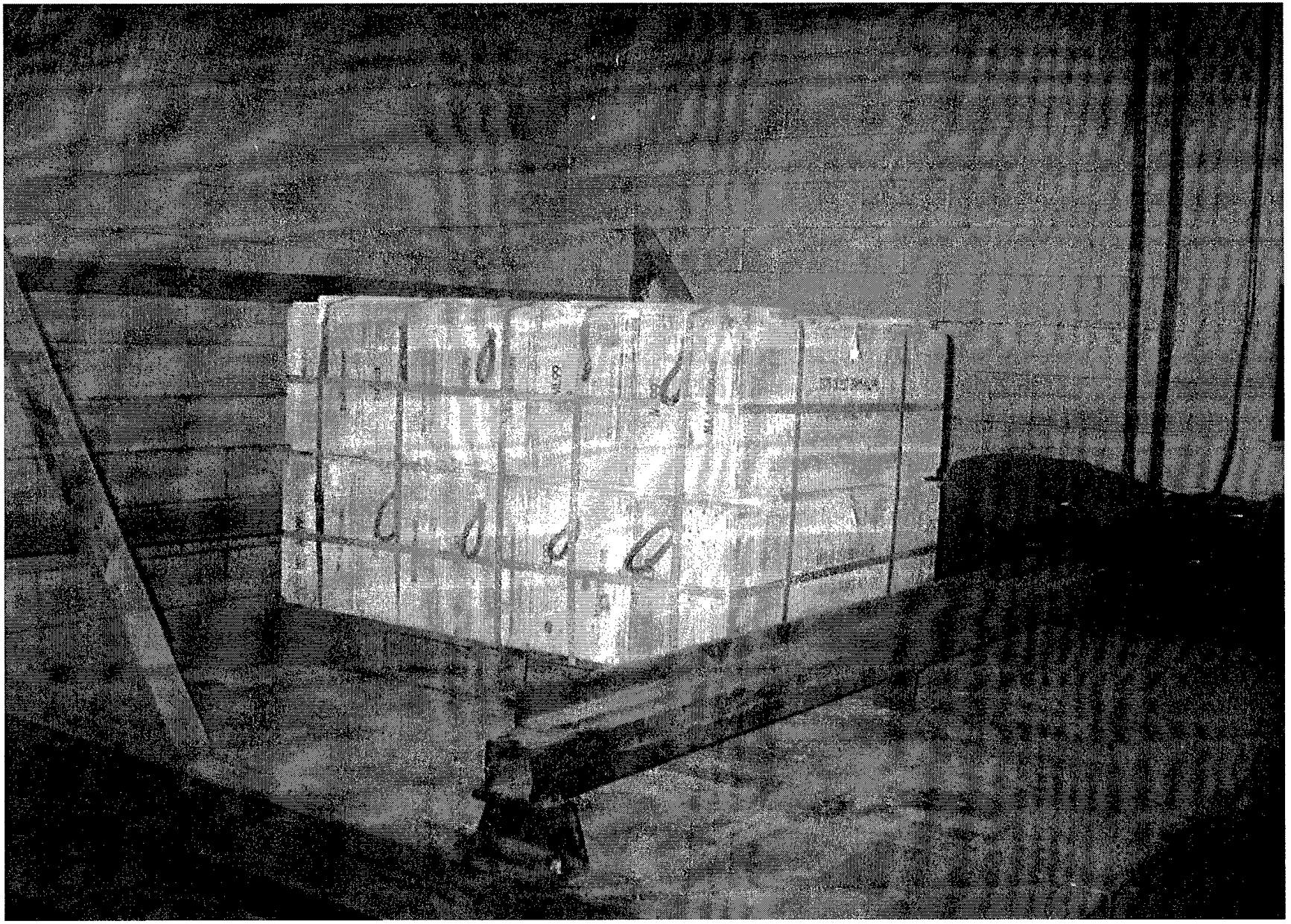
	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
AO317-SPN-96-089-1156. This photograph shows the armor tile pallet (palletization method no. 1) raised in preparation for the edgewise rotational drop test.		



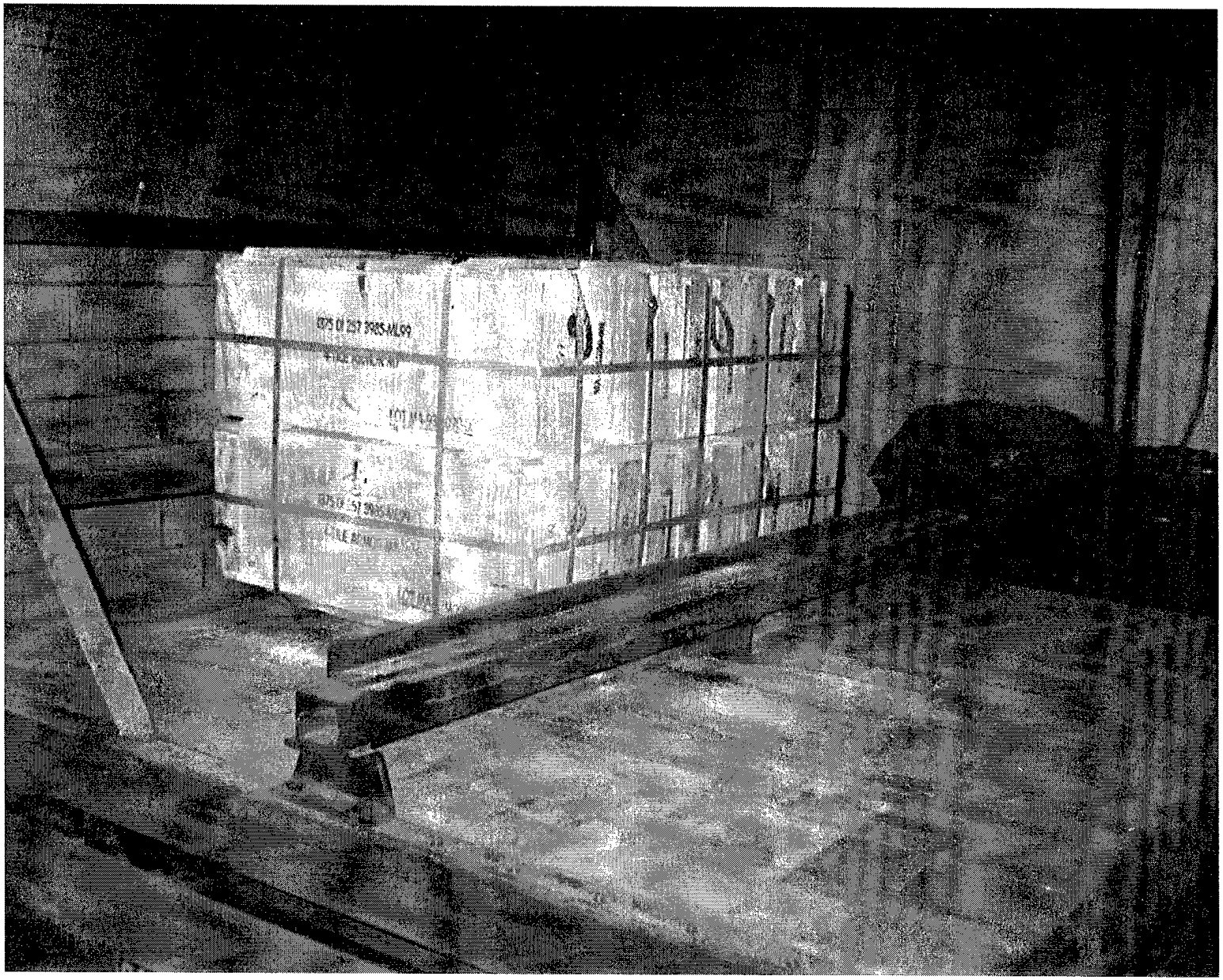
	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
AO317-SPN-96-089-1160. This photograph shows the armor tile pallet (palletization method no. 1) on the incline-impact tester.		



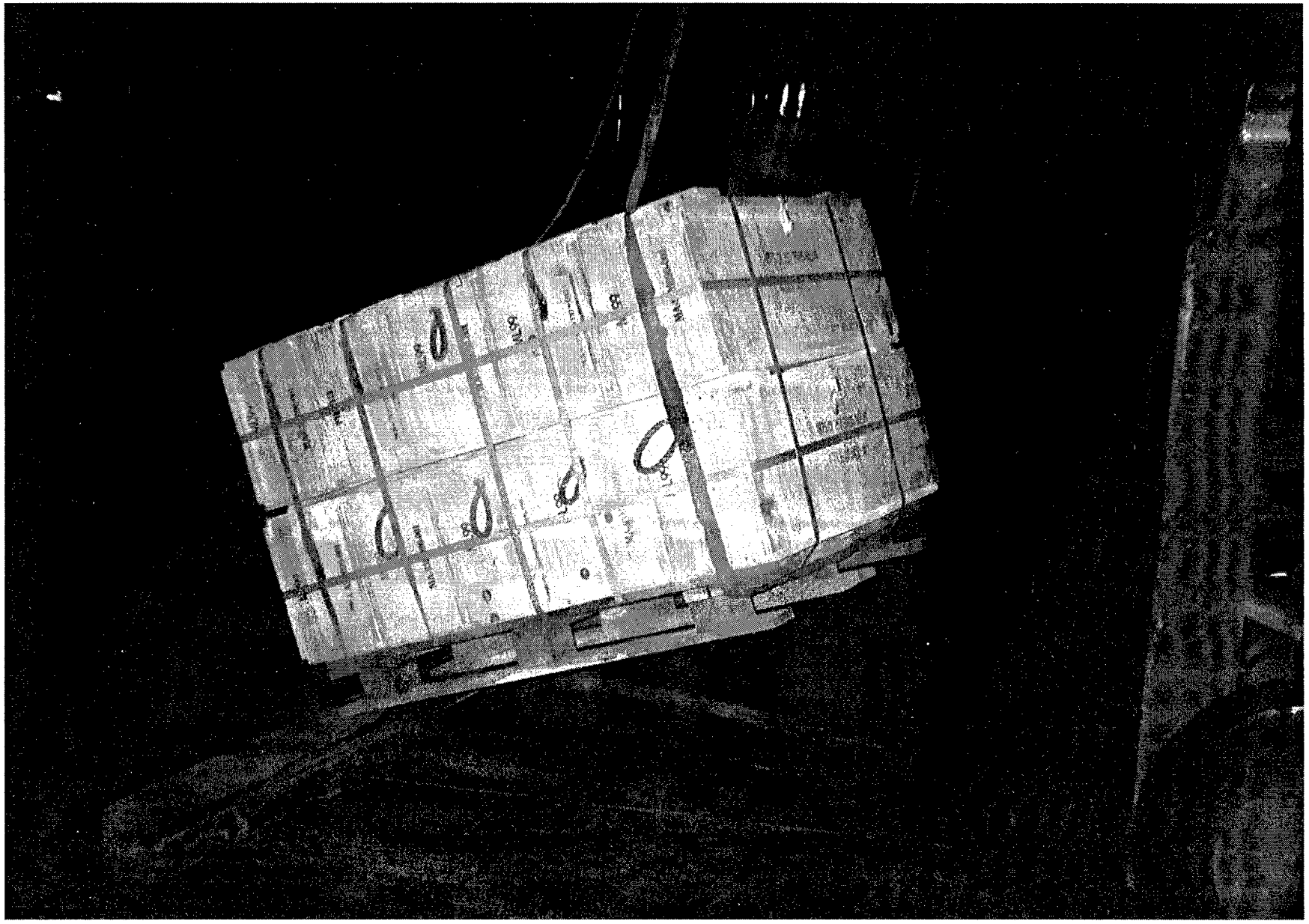
	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
AO317-SPN-96-089-1140. This photograph shows the armor tile pallet (palletization method no. 2) in the compression tester.		



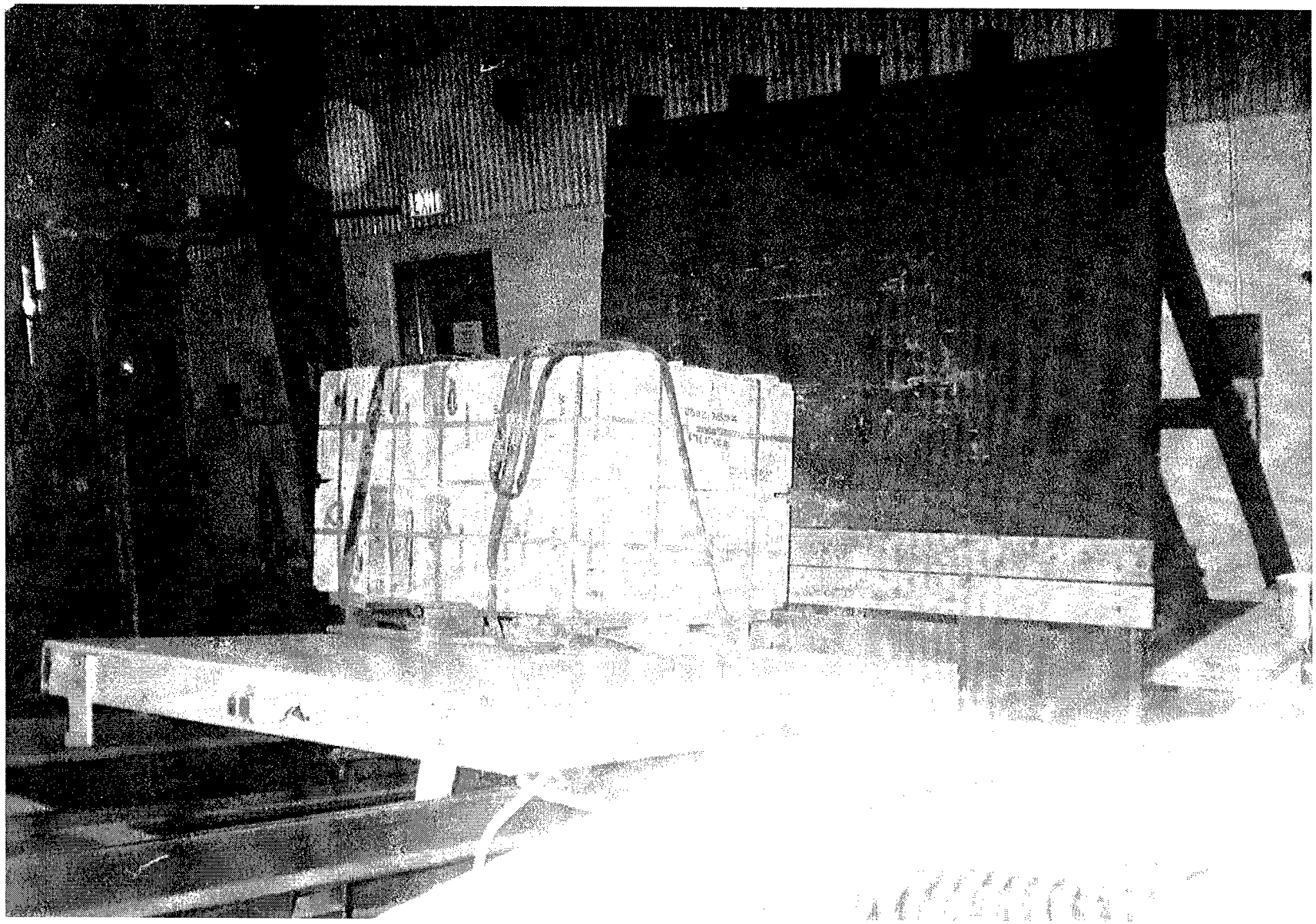
	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
AO317-SPN-96-089-1141. This photograph shows the armor tile pallet (palletization method no. 2) on the vibration table in the longitudinal orientation.		



	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
AO317-SPN-96-089-1142. This photograph shows the armor tile pallet (palletization method no. 2) on the vibration table in the lateral orientation.		



	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
AO317-SPN-96-089-1143. This photograph shows the armor tile pallet (palletization method no. 2) raised in preparation for the edgewise rotational drop test.		



	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
AO317-SPN-96-089-1146. This photograph shows the armor tile pallet (palletization method no. 2) on the incline-impact tester.		

PART 7

DRAWINGS

UNITIZATION PROCEDURES FOR ARMOR TILE, M7, PACKED 4 PER WOODEN BOX, UNITIZED 10 BOXES PER 35" X 45-1/2" PALLET; APPROX BOX SIZE 36-1/4" L X 9-7/8" W X 14-3/4" H

THIS PROCEDURE IS A ONE TIME USE PLYWOOD BOX, STAPLE CONSTRUCTION, HASP ON THE SIDE.

PREPARED FOR WALTER HOLCOMBE
JANUARY 1996 BY:
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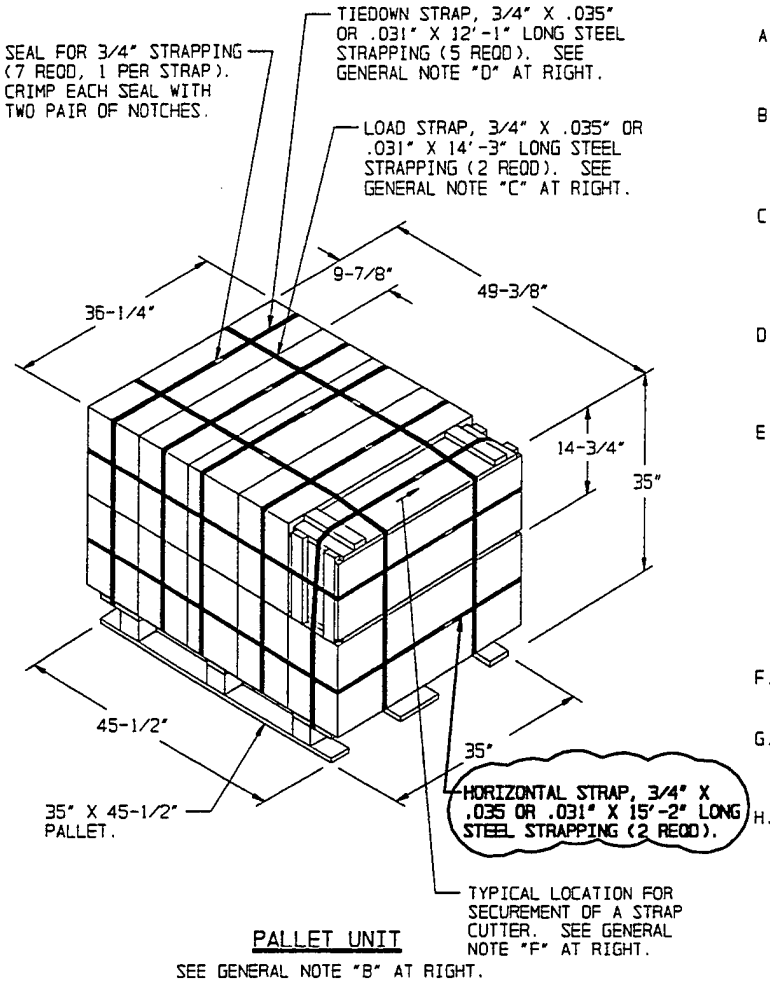
ACTING CHIEF, SUPPLY ENGINEERING DIVISION

DO NOT SCALE



PALLET UNIT

SEE GENERAL NOTE "B" AT RIGHT.

10 BOXES OF ARMOR TILES (4 PER BOX) AT 128 LBS	1,280 LBS (APPROX)
DUNNAGE	7 LBS
PALLET	65 LBS
TOTAL WEIGHT	1,352 LBS (APPROX)
CUBE	36.3 CU FT (APPROX)

BILL OF MATERIAL

PALLET, 35" X 45-1/2"	1 REQD	65 LBS
STEEL STRAPPING, 3/4"	88.92' REQD	6.35 LBS
SEAL FOR 3/4" STRAPPING	7 REQD	NIL

THIS PROCEDURE IS A ONE TIME PLYWOOD BOX, STAPLE CONSTRUCTION, HASP ON THE SIDE.

MATERIAL SPECIFICATIONS

PALLET: MIL SPEC MIL-P-15011; 4-WAY ENTRY, STYLE 1A, TYPE I, CLASS 1, PRESERVATIVE TREATED. SEE GENERAL NOTE "J".

LUMBER: SEE TM 743-200-1 (DUNNAGE LUMBER) AND FED SPEC MM-L-751.

NAILS: FED SPEC FF-N-105; COMMON. ALT: ANNULAR-RING TYPE NAIL, PALLET TYPE (MECHANICALLY DEFORMED) NAIL, OR COOLER NAIL OF SAME SIZE.

STRAPPING, STEEL: ASTM D3953; FLAT STRAPPING, TYPE 1, HEAVY DUTY, FINISH B (GRADE 2), SIZE 3/4" X .035" OR .031".

SEAL, STRAP: ASTM D3953; CLASS H, FINISH B (GRADE 2), DOUBLE NOTCH TYPE, STYLE I, II, OR IV.

GENERAL NOTES

A. THIS DOCUMENT HAS BEEN PREPARED AND ISSUED IN ACCORDANCE WITH AR 740-1 AND AUGMENTS TM 743-200-1 (CHAPTER 5) AND CONFORMS TO MIL-STD-1660.

B. DIMENSIONS, CUBE AND WEIGHT OF A PALLET UNIT WILL VARY SLIGHTLY DEPENDING UPON THE ACTUAL DIMENSIONS OF THE BOXES AND THE WEIGHT OF THE SPECIFIC ITEM BEING UNITIZED.

C. THE LOAD STRAPS MAY BE THREADED THROUGH THE STRAP SLOTS OF A PALLET OR PRE-POSITIONED ON THE PALLET DECK PRIOR TO PLACING BOXES ON THE PALLET. LOAD STRAPS MUST BE TENSIONED AND SEALED PRIOR TO APPLICATION OF TIEDOWN STRAPS.

D. INSTALL EACH TIEDOWN STRAP TO PASS UNDER THE DECK/STRINGER BOARDS OF THE PALLET AND TO BE LOCATED AS SHOWN. TIEDOWN STRAPS WILL NOT BE APPLIED UNTIL THE LOAD STRAPS HAVE BEEN TENSIONED AND SEALED.

E. THE FOLLOWING AMC DRAWINGS ARE APPLICABLE FOR OUTLOADING AND STORAGE OF THE ITEMS COVERED BY THIS DRAWING.

CARLOADING - - DRAWING 19-48-4115-5PA1002
TRUCKLOADING - DRAWING 19-48-4117-11PA1003
STORAGE - - - DRAWING 19-48-4118-1-2-3-4-14-22PA1002
END OPENING ISO CONTAINER - - DRAWING 19-48-4153-15PA1002
MILVAN - - - - DRAWING 19-48-4166-15PA1003
SIDE OPENING ISO CONTAINER - - DRAWING 19-48-4267-15PA1009

F. FOR METHOD OF SECURING A STRAP CUTTER TO THE PALLET UNIT, SEE AMC DRAWING 19-48-4127-20P1000.

G. IF ITEMS COVERED HEREIN ARE UNITIZED PRIOR TO ISSUANCE OF THIS APPENDIX, THE BOXES NEED NOT BE REUNITIZED SOLELY TO CONFORM TO THIS APPENDIX.

H. WHEN APPLYING ANY STRAP, CARE MUST BE EXERCISED TO ASSURE THAT THE END OF THE STRAP ON THE UNDERSIDE OF THE JOINT EXTENDS AT LEAST 6" BEYOND THE SEAL. THIS EXTRA MINIMUM LENGTH OF STRAP IS REQUIRED TO PERMIT SUBSEQUENT TIGHTENING OF LOOSENED STRAPPING. RETENSIONING CAN BE ACCOMPLISHED WITHOUT REPLACING STRAPPING OR SPLICING STRAPPING THROUGH THE USE OF A FEEDWHEEL TENSIONING TOOL, MANUAL OR PNEUMATIC, AND THE APPLICATION OF ONE ADDITIONAL SEAL.

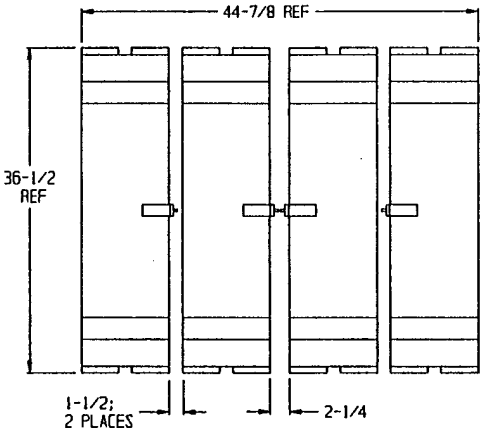
J. ALL WOODEN DUNNAGE AND PALLETS MUST BE PRESERVATIVE TREATED WITH EITHER COPPER-8-QUINOLINOLATE OR ZINC NAPHTHENATE EMULSIFIABLE. PALLETS AND DUNNAGE ASSEMBLIES MUST BE ASSEMBLED PRIOR TO TREATMENT. THE LETTERS "PA" DENOTING P056 (COPPER-8-QUINOLINOLATE) OR "PB" DENOTING M-GARD W550 (ZINC NAPHTHENATE EMULSIFIABLE) MUST BE APPLIED TO THE OUTER FACE OF THE CENTER POSTS ON THE 45-1/2" SIDES OF THE PALLET IN LETTERS AT LEAST ONE-INCH HIGH.

K. A PLUS OR MINUS 1/4" IS ALLOWED ON OVERALL DIMENSIONS OF ANY DUNNAGE ASSEMBLY. HOWEVER, SIMILAR PIECES IN AN ASSEMBLY MUST BE WITHIN 1/8" OF THE SAME DIMENSION.

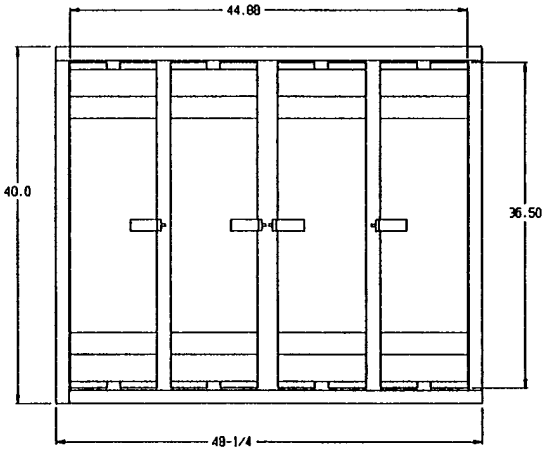
L. IN ORDER TO OBTAIN COMPACT (SOUND) UNITS, ALL STRAPS SHALL BE LOCATED IN PROPER ALIGNMENT AND TENSIONED UNTIL THEY CUT INTO THE EDGE OF THE PALLET DECK. AFTER TENSIONING, ALL STRAPS WILL BE SECURED USING ONE SEAL AND TWO PAIR OF NOTCHES.

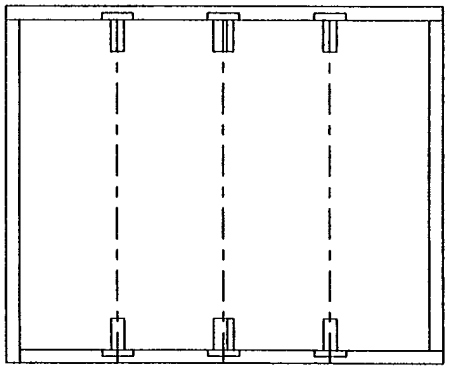
M. DIMENSIONAL LUMBER SPECIFIED THROUGHOUT THIS PROCEDURAL DRAWING IS OF NOMINAL SIZE UNLESS OTHERWISE SPECIFIED. FOR EXAMPLE, 1" X 4" MATERIAL IS ACTUALLY 3/4" THICK BY 3-1/2" WIDE AND 2" X 4" MATERIAL IS ACTUALLY 1-1/2" THICK BY 3-1/2" WIDE.

N. THE STYLE 1A PALLET DELINEATED IN THE DETAIL AT LEFT NEED NOT HAVE CHAMFERS OR STRAP SLOTS AS SPECIFIED WITHIN MILITARY SPECIFICATION MIL-P-15011 WHEN USED FOR UNITIZATION OF THE ITEMS COVERED BY THIS APPENDIX.

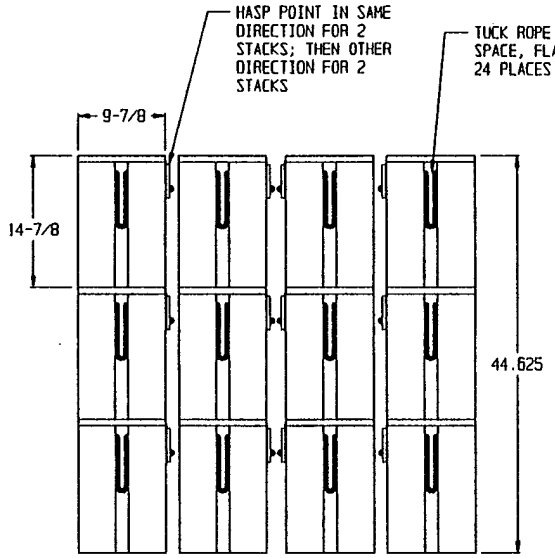


PLAN VIEW OF STACK

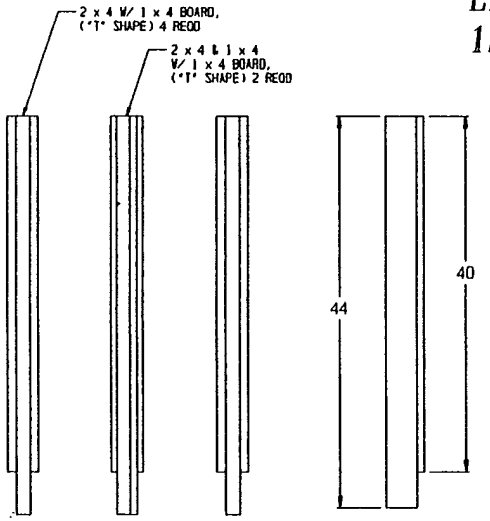


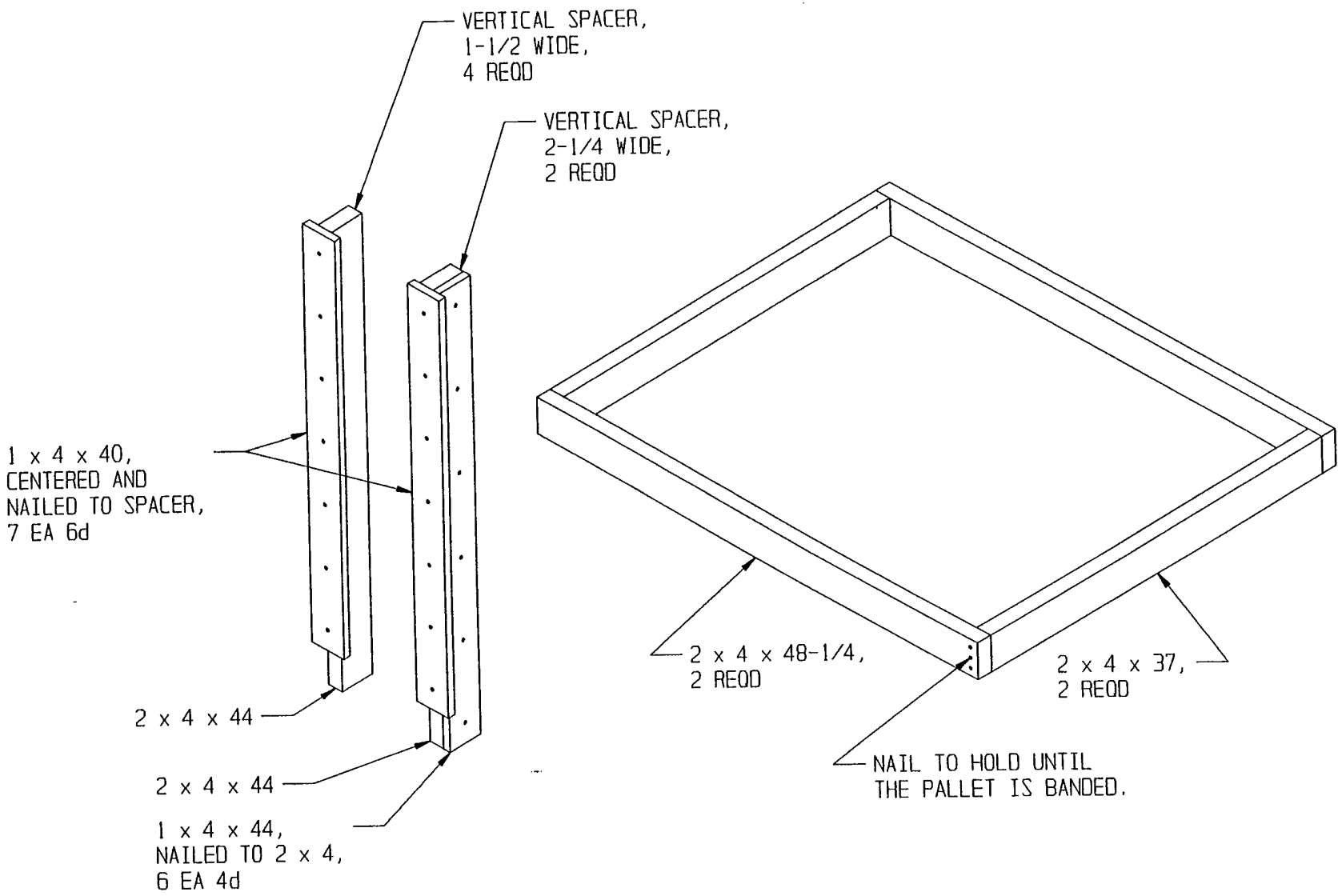


LAYOUT FOR ARMORED TILE, 12 BOX PALLET, BANDED



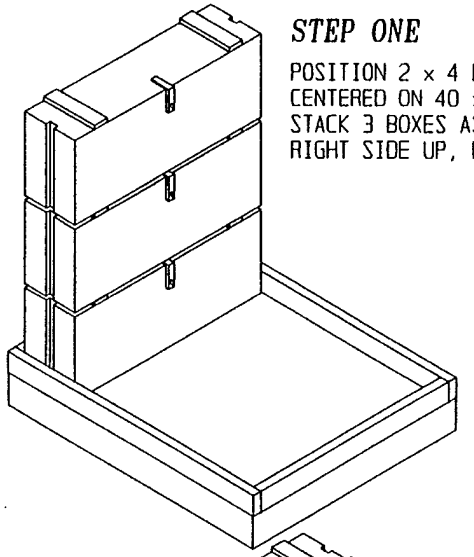
SIDE VIEW OF STACK




VERTICAL SPACER,
1-1/2 WIDE,
4 REQD
VERTICAL SPACER,
2-1/4 WIDE,
2 REQD
1 x 4 x 40,
CENTERED AND
NAILED TO SPACER,
7 EA 6d
2 x 4 x 44
2 x 4 x 44
1 x 4 x 44,
NAILED TO 2 x 4,
6 EA 4d
2 x 4 x 48-1/4,
2 REQD
2 x 4 x 37,
2 REQD
NAIL TO HOLD UNTIL
THE PALLET IS BANDED.

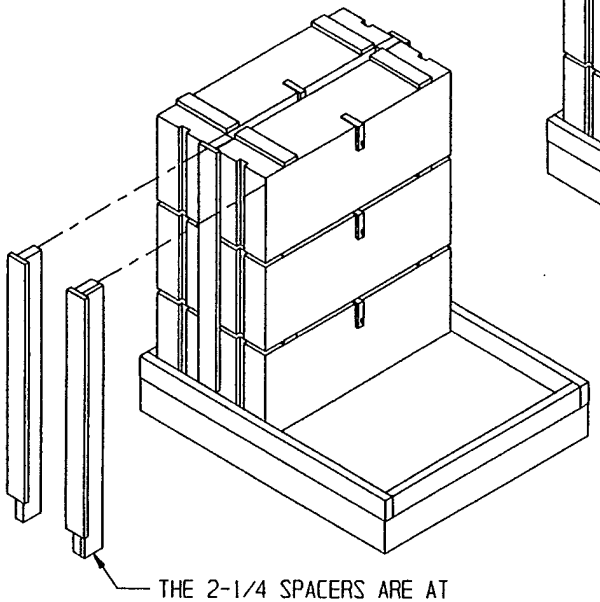
STEP ONE

POSITION 2 x 4 FRAME
CENTERED ON 40 x 48 PALLET.
STACK 3 BOXES AS SHOWN;
RIGHT SIDE UP, HASP FACING IN.



STEP TWO

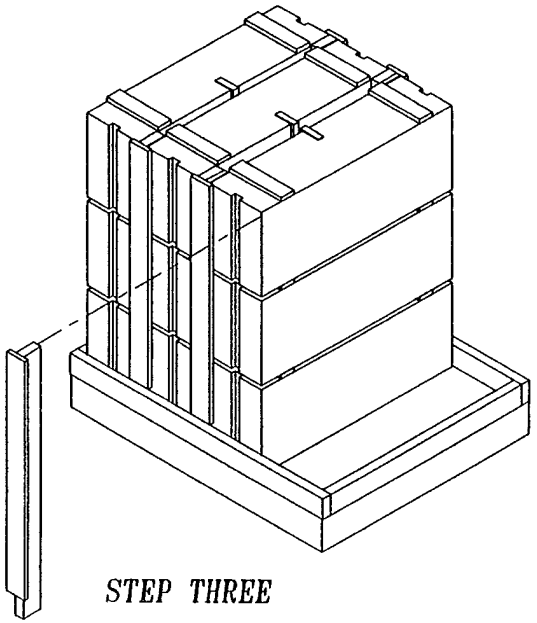
INSERT 2 "T" SHAPED SPACERS WHICH ARE 1-1/2 INCHES WIDE NEXT TO FIRST STACK AT EACH END. STACK 3 MORE BOXES AS BEFORE. INSERT 2 "T" SHAPED SPACERS WHICH ARE 2-1/4 INCHES WIDE AT EACH END AS BEFORE.



THE 2-1/4 SPACERS ARE AT THE CENTER OF THE LOAD TO PROTECT THE HASP FACING TOWARDS EACH OTHER..

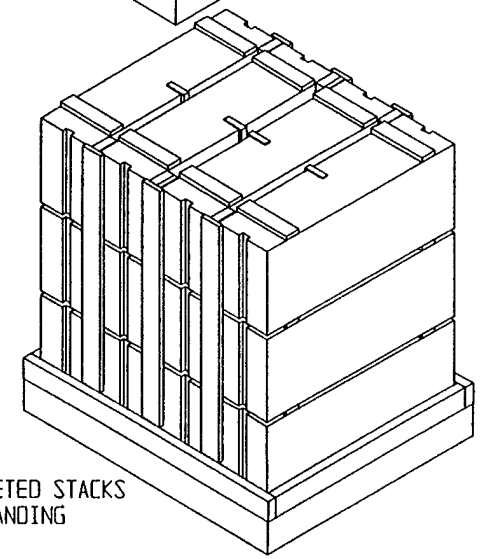
STEP THREE

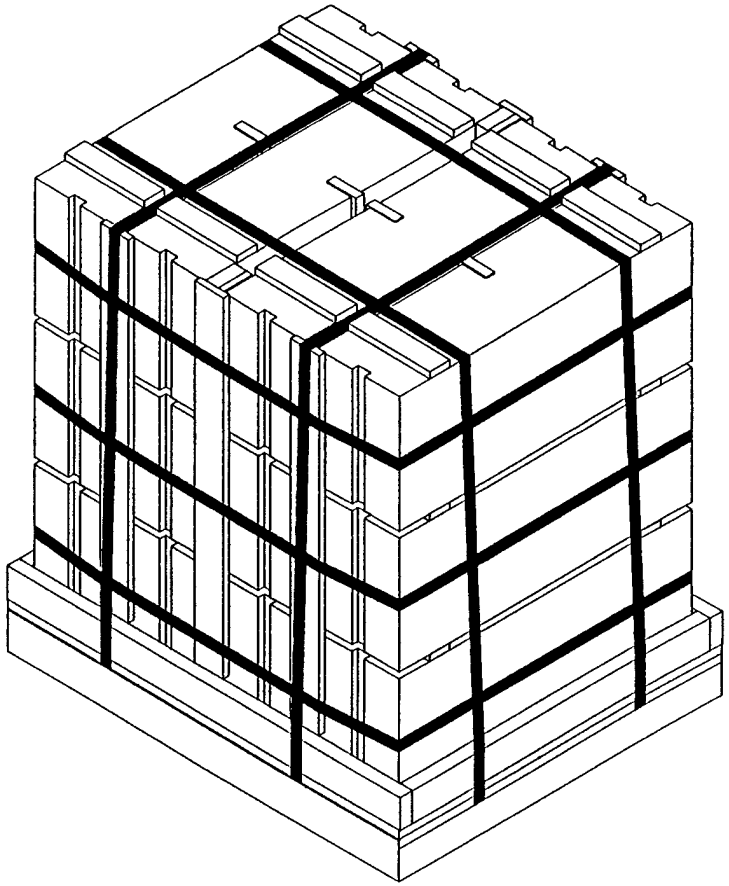
STACK 3 MORE BOXES AS SHOWN; RIGHT SIDE UP, HASP FACING IN TOWARDS FIRST 6. INSERT 2 "T" SHAPED SPACERS WHICH ARE 1-1/2 INCHES WIDE AT EACH END OF NEW STACK. FINISH STACKING THE 12 BOXES, HASP FACING IN.



STEP FOUR

THIS IS THE COMPLETED STACKS READY FOR STEEL BANDING





NOTES:

1. PLACE 3 HORIZONTAL 1-1/4 STEEL BANDING CENTERED ON EACH BOX LAYER. USE 2 STAPLES AT 2 X 4 SPACERS EACH SIDE FOR EACH HORIZONTAL BAND.

2. RUN 2 VERTICAL BANDS AT ENDS BETWEEN BOX CLEATES AND UNDER PALLET DECK BOARDS.

3. RUN 2 VERTICAL BANDS AT SIDES CENTERED ON THE 2 EACH 1-1/2 WIDE SPACER BOARDS AND UNDER THE PALLET DECK BOARDS. NOTE THIS BANDING IS BETWEEN THE BOX CLEAT ENDS.